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TELEPHONE LINES.

THE recent concessions granted to the telephone companies by the late lamented Postmaster-General will, there can be no doubt, give rise to the provision of a large number of telephone lines. Already trunk lines are being erected between most of the large centres of commerce and their most important neighbouring towns. To what extent this will continue it is impossible to say, but that there will be very large extensions of the telephone system is a conclusion at which most people will have arrived ere this.

Under these circumstances, the system to be adopted in the erection of the wires upon these trunk lines is a question of considerable importance not only to the telephone companies, but to those for whose use the wires are provided, and equally to those by whom they have to be maintained. As a rule the railway routes are in the hands of the State, acquired by it under the Telegraphs Act, 1868, and by more recent legislation. The main road routes have also been pretty well covered by the State, so that there remain but few channels open to the telegraph companies. It would, therefore, appear probable that the telephone companies will, to a great extent, be dependent upon the postal department for the provision of very many of the wires they may require either by road or railway route. Whether such should prove to be the case or not, the broad question of the system to be pursued in the erection of such lines remains to be considered.

The course hitherto adopted, and up to the present with entire success, is that known as the "twisted" system; a system which provides for a constant crossing or turning of the wires so that their relative positions are frequently varied.

Although we have not noticed wires so erected, we cannot but think that were they run parallel, terminated at given distances, and crossed at those points, such a system would afford excellent results. Under the "twisted" system there are no intermediate terminations. The wires are run continuously, their position on the poles being varied as prescribed. To the lineman their appearance must be anything but gratifying. How it is possible for him to trace a given wire when faulty, especially when viewed from a railway train in motion, is a question which will probably be more easily answered by the theorist than by the practical man. The space between wires so arranged must necessarily be, at points, less than where they are maintained parallel, and this being so, the probability is that they will be subject to more faults than parallel wires. Moreover, the system is one which makes no provision for any ready changes in the relative positions of the wires. To effect such changes, the wires to be changed must first be terminated at the points selected for the crossing.

With the parallel system, with crossings at certain points—say every quarter or half mile pole—all these difficulties disappear. A proper regulation is easily secured; any irregularity is at once observable, and the lineman can readily follow out his wires. It is well worth considering whether such a system is not preferable. It would probably, to the extent of two or three shillings per mile, prove more expensive than the twisted system; but this is by no means certain, for with the parallel system, crossed at different points, the running of the wires would be more easily carried on, and it is questionable if the labour so saved would not compensate for the cost of the additional terminations. Certain it is that such a system offers to the engineer a ready means of effecting far more radical changes in the relative position of wires than any other system; a point of the utmost importance in telephone wires. Sufficient time has not elapsed to afford experience of the twisted system, either in the production of faults or difficulty of maintenance. Whatever difficulties may in this respect attach to the system, will not in all probability present themselves for some few years after the erection of the lines. It is this fact which induces us to direct attention to the subject, in order that it may be well considered by those who are interested in it, ere the erection of additional lines is taken in hand.

ELECTRICALLY PROPELLED TRAMCARS,

In the ELECTRICAL REVIEW, as in other technical journals, much has been said with regard to the substitution of electrical energy for horse-flesh for propelling tramcars.

There is at the present moment an interesting discussion going on between the members of the Institution of Civil Engineers on the subject of steam-tramways, and this is, therefore, not an inopportune time to make it known that during the last few months a series of important experiments has been carried out in a quiet and systematic way with a view of determining the value of secondary batteries, in conjunction with electromotors, for the propulsion of tramcars in crowded cities.

The gentleman with whose name these valuable tests are associated has already done much serviceable work in this direction, and we may now positively state that Mr. A. Reckenzaun, C.E., has designed, and the Electrical Power Storage Company constructed, a really efficient apparatus which promises to give the handiest means of locomotion that has ever been placed upon street rails.

For more than two months past a car has been travelling on a line laid down for experimental purposes by the before-mentioned company in its extensive premises at Millwall. The tramway (4 ft. 8½ in. gauge) is 400 ft. in length, and, from the nature of the ground-space at the company's disposal, forms approximately a right angle of nearly equal sides, the apex of the angle making a curve of only 35 ft. radius.

From one end as far as the commencement of the curve,

the road is tolerably level, but with this curve commences an incline of 1 in 40, gradually rising until it reaches a maximum of 1 in 17 near the end of the up-journey.

It is, therefore, a matter of impossibility to make a rush for the hill on account of the sharp curve intervening, and the experiments made on such a difficult line are consequently of more than ordinary value.

The car itself is an old one procured from one of the metropolitan tramways, and it has done many years' service whilst drawn by horses on the Greenwich-Westminster line. The body of this vehicle weighs 2½ tons, and it accommodates 46 passengers.

Tramcars propelled by secondary batteries have been made and experimentally run in London, Paris, and Brussels, but, hitherto, little or no success has attended the efforts of the promoters of the systems involved in these trials. Many electricians and scientists have emphatically pronounced the accumulator method of obtaining motive power for such purposes as impracticable, the main reason for this denunciation resting on the fact that the batteries were much too heavy, and that the bulk of their stored energy was wasted in propelling their own weight. The Electrical Power Storage Company has, however, found good reasons for believing that the contrary can be proved, and that in the future the motive power appliances will form but a minor portion of the total weight of car and passengers. The secondary cells furnishing the electrical energy for the car under notice are of a special type manufactured by, and under the patents of the Storage Company, to the designs of Mr. Reckenzaun. Placed under the seats of the car in long trays, which run on rollers for their speedy removal, they are out of sight, and the whole car internally and externally has nothing whatever strange in its appearance; it looks indeed similar to an ordinary tramcar propelled without horses or other visible motive power. The electromotor and gearing (made under Reckenzaun's patents) are placed beneath the car and occupy so little space that, to a casual observer, they are unperceived. The absence of noise, vibration, or any disagreeable feature, makes a journey in this car most enjoyable. The speed may be varied from 3 to 10 miles an hour by a most simple contrivance, and any person quite unacquainted with technical details can drive with perfect confidence. Returning again to the secondary batteries, these have been of late so much improved that great power may now be drawn from a small weight of material without sacrificing either efficiency or durability. The weight of the cells employed in propelling the car is about 1¼ tons, the motor, gearing, and accessories bringing up the total weight for motive power to 1¾ tons; and this for a car which, with its full complement of passengers, weighs in itself 5½ tons. The electrical arrangements are such that if at any moment it should become necessary a power equal to that of 16 horses can be furnished.

Comparing the above weight, says Mr. Reckenzaun, with that of a steam or compressed air tramway locomotive, either of which will weigh some eight or ten tons to do the same amount of useful work, it must be admitted that stored electrical energy has the advantage in proportion of about 5 to 1 so long as the propelling force is directly proportional to the weight moved. Much has been written concerning the waste of power which occurs when secondary cells are used for the purposes of locomotion. The conversion of energy has to pass through various stages, which we need not particularise; but we are assured that it can be shown, from prolonged experiments and practice, that the total loss of energy, with all its transformations, is only 66 per cent. between the steam engine used for driving the charging dynamo and the tram-rails. It is known that tramway steam locomotives consume from three to four times as much fuel per horse-power as large stationary engines such as would be employed for actuating dynamo-electric machines, and, bearing this in mind, an efficiency in the electrical tramcar far below that quoted would still be considered economical. The prime cost of electrically propelled cars with the charging stations would be less than that for steam cars, and the depreciation, repairs to machinery, &c., must also be less on account of the few wearing parts, and the complete protection from dirt. As far as the accumulators are concerned, their depreciation is low, as lead is cheap and the renewal of positive plates easy, involving but little skilled labour.

The running cost, including 15 per cent. depreciation on machinery and 50 per cent. on accumulators, comes to 3½d. per car mile, which is about one-half the expense attached to "horsing" on tram lines.

The car on the line at Millwall runs for two hours with one charge, starting, stopping, and reversing every minute, and the discharged batteries can be replaced almost as quickly as is the case when changing horses. This is accomplished by means of a trolly which brings up and removes the trays of cells, the trays, as already stated, running on rollers.

The whole of the arrangements, both electrical and mechanical, have been well and carefully worked out in every detail. The entire weight of the car is properly distributed over the small "bogie" frames, so that no objection can be raised on the part of tramway companies using light rails laid for horse car traffic. Old rolling stock can be readily utilised by merely placing the "bogies" which carry the motor under the car, and fitting the space under the seats for the reception of accumulators. The car is brilliantly illuminated at night by four 20-candle power Swan lamps, and bell pushes inside the vehicle enable the passengers to signal to driver and conductor at the same time, by the ringing of electric bells.

We were considerably impressed, on the occasion of a recent inspection, with the admirable and really practical results obtained; and we have no hesitation in saying that electric locomotion should make a decided advance through the medium of Mr. Reckenzaun's persistent endeavours. We shall hope ere long to be able to chronicle the complete success of this car in practical working in competition with horses, the intention being to run it publicly in a few days.

ON PERSONAL SAFETY WITH ELECTRIC CURRENTS.

THE serious accidents which have occurred within the past four or five years through accidental contacts with wires carrying strong electric currents have seemed to call attention to the necessity of providing safeguards against such mishaps. It is probable that carelessness has been the cause of most of the accidents reported, and it is true that if weak currents only were used nobody could be hurt. It is, however, worth while to consider the electrical relations of the human body in order to learn where danger lies. Prof. A. E. Dolbear, in the *Electrical World*, says:—"I have noted in various places the opinions of different persons as to what constituted a safe current. In one of the old books it is stated a 'spark eighteen inches long begins to be dangerous.' In another place one says that a difference of potential of 800 volts is too high an electromotive force for individual safety.

"Now a difference of potential of 1,000 volts will not give a jumping spark the hundredth of an inch long. The electromotive force developed by the Holtz machine may be as high as 50,000 volts, and the spark from it will at most give a spasmodic jerk to the elbow, and no manner of hurt come of it or of repeated shocks from it, so that more than difference of potential must be considered in determining what is dangerous about electricity. The ability of electricity to do work of any kind, destructive physiological work as well as any other, depends upon both difference of potential and current strength, and the amount of work is proportional to the time also. Now the discharge from a Holtz machine through a short wire may give a very strong current; for example, let $E = 50{,}000$ volts, $R = \cdot001$ ohm, then $\frac{50{,}000}{\cdot001} = 50{,}000{,}000$—fifty millions of ampères; but the wire may show no sign of being

injured, for the time of the current passage was too short, probably less than the millionth of a second. If the discharge had continued for an appreciable part of a second the wire would have been vaporised. The discharge is probably equally quick when taken on the knuckles, but there is not enough energy to hurt anything. Again, the amount that will traverse any conductor, with a given difference of potential between its ends, will vary inversely as its resistance, and for the human body it may only roughly be calculated. The resistance of the body is very great. Many measurements made with different individuals taking wires in their fingers and hands, gives a resistance varying between 6,000 and 15,000 ohms; but this depends in a large degree upon the moisture of the skin when contact is made. Hands which are ordinarily dry have a high resistance; the same hands moist with perspiration or purposely wetted may lose half their resistance. Dr. Stone, of London, has made many experiments, and finds that the resistance of the body may be reduced to 500 ohms or less, by having the skin soaked.

"On an arc light circuit with forty lamps the difference of potentials will be about 2,000 volts. If a man with a dry, thick skin were to grasp the terminals at the dynamo, the current that would go through him would be $\frac{2000}{10000} = \cdot 2$ of an ampère, and in one second two-tenths of a coulomb would have traversed his arms. If the same hands were soaked, the current might be $\frac{2000}{500} = 4$ ampères, or four coulombs per second. In the first case there would have been spent in him an amount of energy equal to $2{,}000 \times \cdot 2 = 400$ watts, or more than half a horse-power, and in the second case $2{,}000 \times 4 = 8{,}000$ watts or $\frac{8000}{746} = 10{\cdot}7$ horse-power. Now any electromotive force above about 1·5 volts is sufficient to decompose water, and it has been shown that the fluids of the body are better conductors of electricity than any of the tissue, even the nerves: it may fairly be inferred that such a current with such an electromotive force might decompose a notable quantity of the fluids of the body into their constituent gases.

"To determine the highest limit of safety would require experiments which no human beings would be willing to submit to. Animals might be employed, perhaps; but if 800 volts have at any time proved to be dangerous, one may set a lower limit to the resistance of the body, and determine the current strength $\frac{800}{1000} = \cdot 8$ ampères. That result looks threateningly large, but it is because the resistance is made so low. I have never found one less than 5,000 ohms, then $\frac{800}{5000} = \cdot 16$ ampères. But that represents 128 watts—a quantity of energy no one would care to have spent in him. After all, what would be safe for one would be entirely unsafe for another; so that each individual would have his own factor of safety, or the difference of potential which he could work with, with impunity. From what we now know it would seem as if one-tenth of an ampère current body was as much as any one could safely have traverse his body for one second. If then he fixes his minimum resistance, the product of the two will give him the E.M.F. which he may feel timidly safe with. Thus, if one's resistance with wet hands is found to be 8,000 ohms, then $8{,}000 \times \cdot 1 = 800$ volts; while if his resistance was only 1,000 ohms, he could only venture to touch wires having a difference of potential of $1{,}000 \times \cdot 1 = 100$ volts. The ordinary incandescent light circuit would be on his limit."

A NEW THEORY ON THE "HALL EFFECT."*

THE writer suggests a very simple explanation for this famous "puzzle," which has exercised the scientific world for three or four years past. If we arrange a strip of metal through which a current of electricity is flowing, as shown by the arrows in fig. 1, with the poles of a powerful electro-magnet above and below its centre, and then touch the galvanometer terminals, 1 and 2, to the edges of the strip at the points, *b* and *a*, exactly opposite, no current flows through the galvanometer, G. But when the electro-magnet is energised by a strong current, a current is caused to flow through the galvanometer. Why?

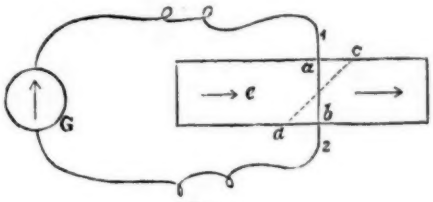

FIG. 1.

Mr. Hall supposes that the equi-potential line, *b*, *a*, has been rotated out of the vertical to the position, *c*, *d*, and that so long as the magnet acts the point *a* is at a higher potential than *b*, and the current through the galvanometer results from the flow from the higher to the lower potential. Without stating the various objections to this view, is it a reasonable supposition? If we suppose it to be true that the point *a* is at a higher potential than *b* (the two points being exactly opposite to each other), we shall have a certain flow from *a* towards *b*. Will not this equalise the potential *in the strip itself?* It is certainly very easy to go from *a* to *b*, through a good conductor like gold. Is it not unreasonable to suppose that the equalisation of potential will take place through the external circuit 1, G, 2 at all, under the conditions stated? Moreover we have no reason, except the existence of a current through G, to suppose that there *is* any difference of potential between *b* and *a*. It is a forced explanation at best, and if we can satisfactorily account for this current by the action of known and undisputed electrical laws, that explanation should prevail.

Mr. Shelford Bidwell supposes the phenomenon to be the effect of strain and thermal currents, while Prof. Silvanus P. Thompson ascribes it to a change of the electrical resistance of the strip under the action of the powerful magnet, and Mr. W. H. Preece believes it to be due to contraction and dilation of the molecules of the strip under that action.

Now, may not this outside current be due to simple attraction and repulsion between the magnetic lines of force of the magnet and of the current through the strip? Let N and S, in fig. 2, be the poles of the magnet, having the metal strip, *e*, between them (shown in cross section), with the galvanometer terminals, 1 and 2, touching its sides at the equi-potential points *b* and *a*, as in fig. 1. So long as the magnet is inert, no current flows through F, although a current is flowing through *e*. But when the magnet is energised a current flows, we will say, in the direction 1, G, 2. Fig. 2 is merely a diagram of the apparatus.

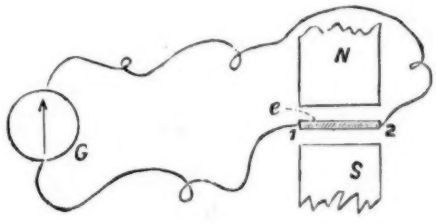

FIG. 2.

In fig. 3 we see the magnetic lines of force from the pole N to pole S (the middle portions being omitted for the sake of clearness), and also the magnetic "whorls" of the current flowing through the strip, *e*, the direction of the lines of force being shown in each case by the arrow-heads; 1 and 2 are the terminals, touching *e*, and the arrows show the direction of the current in them. As the magnetic whorls of *e* come up at the left side (*m*) they are met, "head on," by the lines from pole N. The effect, as we all know, is repulsion, and the result is that a certain portion of the

* *Electrical World.*

magnetic whorls or current is driven through 1 and around through the circuit 1, G, 2. On the right side (*n*) the action is the reverse of that just described, or a drawing-in action through 2, and the result of both is the current through 1, G, 2. To be sure, there are also influences acting in the reverse directions, but the resultant of all the magnetic actions is a minute current through the galvanometer as stated. When the terminals are removed from *b* and *a* to the points *c* and *d* (fig. 1), the current stops, because the difference of potential at the latter points on the conductor, *e*, opposes and offsets

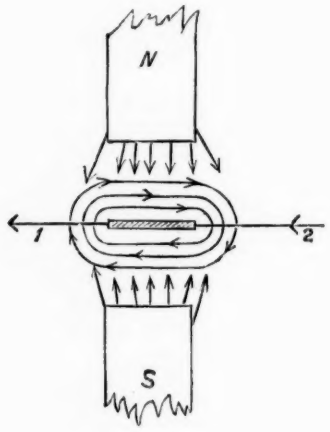

FIG. 3.

the action of the magnet upon the current in *e*. The opposing influences being equal, there is no outside current. But if the magnet is removed, a current is at once observed flowing through the galvanometer, due to *d* being nearer the positive pole of the battery than *c*, and therefore at a higher potential. Thus we explain the whole phenomenon without the necessity of supposing that magnetism can produce a difference of electric potential between two exactly opposite points upon a narrow strip of gold, or other good conductor, through which a current is flowing.

Having sufficiently explained the principle, it will be unnecessary to take up your valuable space by applying this theory to all the possible changes in the conditions, as regards temperature, mode of clamping the strips, paramagnetic and diamagnetic metals, broad poles and narrow or pointed ones, &c., &c. That can easily be done by all who are familiar with the laws of magnetic attractions and repulsions, and they may judge for themselves whether this simple explanation will not account for all the observed results. The writer has from the first believed it to be the true one, but the eminence of the authorities in favour of the rotation theory has heretofore deterred him from offering it publicly. He now does so, asking for it such consideration as it may merit.

SPECIFICATIONS FOR CONTRACTS.

ABOUT a fortnight since a letter signed "Engineer" appeared in the columns of a contemporary complaining that a newly established firm of consulting electricians was asking the sum of three guineas for the specification relating to the electric lighting of the Grosvenor Gallery. As this sum was not returnable "Engineer" had decided not to tender for the work, and expressed the hope that all other electrical engineers would follow his example; and he was at the same time unwise enough to characterise the action of the firm in question as "the latest phase of the confidence trick." A week afterwards other letters on the same subject appeared. One of these came from the pen of Sir Coutts Lindsay, who had instructed Messrs. Mackenzie and Brougham to issue separate specifications and forms of tender for each branch of the work. Two or three communications from well-known firms contained protests against such payments as being unusual. Now as a matter of fact the charge of *x* guineas for a copy of a specification is perfectly legitimate amongst professional men. Payment for such copies is not considered to form any part of their charges for professional assistance upon any contract, but is rather looked upon as a compensation for expenses of clerks engaged in copying, &c.

There are cases, of course, in which it is possible for those wishing to tender for any given contract to obtain specifications free of all charges, but then the contractor who ultimately carries out the work makes an item in his contract price to cover the cost of the whole of the copies which may have been issued to other contractors.

There is no reason whatever why consulting engineers should go to great trouble and expense to produce specifications for contractors to work in accordance with, and then to gratuitously distribute them.

If work is worth doing, or even tendering for, then contractors should have no objection to pay a merely nominal fee for a copy of the specification, as the disbursement can always be included somewhere in the contract price.

It may be that it was thought that Messrs. Mackenzie and Brougham's compilation might contain something which might turn out useful to those who had no real intention of sending in a *bonâ fide* tender for this particular installation; in such a case it is easy to conceive a certain amount of chagrin at being unable to obtain valuable information gratis. At all events the object aimed at appears to have been to limit the competition to those who intended transacting business, and if this has been accomplished well and good.

DYNAMO-ELECTRIC MACHINES.

Experimental Confirmations of the Two Reactions in progress; concerning the Effective Values of the Internal Resistance and of the Inducing Magnetism.

By M. G. CABANELLAS.

THE subjoined table has been drawn up setting out with the data of experiments made with a Gramme machine, model A (workshop), with its magnets strengthened by M. Deprez. The machine was set at the constant speed of 1,110 revolutions per minute, and decreasing resistances were introduced externally, so as to give increasing currents from two ampères up to 42 ampères inclusive. The following are the formulæ which justify the figures included in the columns numbered 1 to 16:—

Columns 1: I.—2: $F = 2\pi c$.—3: $f = \frac{(R_1 + \rho)I^2}{g} \times \frac{60}{N}$.—4: $\frac{F - f}{F}$.—5: $E I = \frac{F N g}{60}$.—6: $(R_1 + \rho) I^2$.—7: The difference of these two quantities, D.—8 and 9: in volts $\frac{D}{I}$, in ohms $\frac{D}{I^2}$.—10: $(R_1 + \rho)$ I. M. Deprez sees the electromotive force of the machine in the quantity calculated by this formula.—11: $E = (R_1 + \rho) I + \frac{D}{I}$.—12 and 13: in ohms $R = R_1 + \frac{D}{I^2}$ in volts R I.—14: Determining function of the individual yield of the generator $m = \frac{E}{R I}$.—15: $F_G = \frac{m-1}{m}$.—16: $\frac{E I}{75 g}$.

Numerical Table confirming the two Reactions in progress: the Effective Values of the Internal Resistance and of the Inducing Magnetism of Dynamo Machines.

Gramme machine, model A, strengthened, at 1,110 revolutions per minute.

Resistance of the ring ... ... $R_a = 0{\cdot}145$

Resistance of the inducer ... ... $R_b = 0{\cdot}195$

Static internal resistance ... $R_i = R_a + R_b = 0{\cdot}340$

Current.	Effort at the Circumference.			Power in Watts-second.			Increase of Internal Resistance.		Electromotive Force.		Effect resisting the internal effective.		Determining Function.	Individual Yield of Machine.	Power supplied to Machine.
	Measured.	Calculated.	Relative difference.	Supplied to Machine.	Employed statically.	Deficiency.			Calculated.	Real.					
1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16
Amp.	kg.	kg.	per cent.	watts.	watts.	watts.	volts.	ohms.	volts.	volts.	ohms.	volts.	Absol. Number.	per cent.	horse power
2	0·120	0·0864	28·	21	16	$5 = \frac{1}{4}$ E I	2·50	$1{\cdot}25 = 9{\cdot}5\ R_a$	8·	10·5	1·59	3·18	3·3	69	0·03
4	0·400	0·3125	21·8	72	59	$13 = \frac{1}{5}$ E I	3·25	0·81	14·75	18·0	1·15	4·60	3·9	74	0·09
6	0·800	0·650	18·7	144	120	$24 = \frac{1}{6}$ E I	4·60	0·76	20·	24·6	1·10	6·60	3·7	73	0·19
8	1·300	1·120	13·85	253	208	$45 = \frac{1}{6}$ E I	5·62	$0{\cdot}70 = 6\ R_a$	26·	31·62	1·04	8·32	3·7	73	0·34
10	2·000	1·650	17·50	362	305	$57 = \frac{1}{6}$ E I	5·70	0·57	30·5	36·20	0·91	9·10	3·9	74	0·50
12	2·700	2·270	15·90	490	420	$70 = \frac{1}{6}$ E I	5·80	$0{\cdot}48 = 4\ R_a$	35·	40·80	0·82	9·84	4·1	75	0·67
14	3·400	2·830	16·75	617	542	$75 = \frac{1}{8}$ E I	5·36	0·38	38·75	44·11	0·72	10·08	4·3	77	0·84
16	4·200	3·175	24·40	762	680	$82 = \frac{1}{9}$ E I	5·12	0·32	42·50	47·62	0·66	10·56	4·5	77	1·04
18	5·000	4·450	11·	907	770	$137 = \frac{1}{9}$ E I	7·61	0·42	42·76	50·37	0·76	13·68	3·7	73	1·23
20	5·800	5·200	10·35	1052	915	$137 = \frac{1}{8}$ E I	6·85	$0{\cdot}34 = 3\ R_a$	45·75	52·60	0·68	13·60	3·8	74	1·43
22	6·800	6·050	11·	1234	1122	$112 = \frac{1}{11}$ E I	5·09	0·23 ,,	51·	56·09	0·57	12·54	4·4	77	1·68
24	7·600	6·900	9·20	1379	1278	$101 = \frac{1}{12}$ E I	4·21	$0{\cdot}18 = 2\ R_a$	53·25	57·46	0·52	12·48	4·6	78	1·88
26	8·300	7·700	7·23	1506	1340	$76 = \frac{1}{20}$ E I	2·92	0·11 ,,	55·	57·92	0·45	11·70	4·9	79	2·05
28	9·200	8·500	7·60	1669	1575	$94 = \frac{1}{17}$ E I	3·35	0·12 ,,	56·25	59·60	0·46	12·88	4·6	78	2·27
30	10·000	9·300	7·	1815	1717	$98 = \frac{1}{19}$ E I	3·27	0·11 ,,	57·25	60·52	0·45	13·50	4·6	78	2·47
32	10·800	10·200	5·55	1960	1863	$97 = \frac{1}{20}$ E I	3·03	0·09 ,,	58·25	61·28	0·43	13·76	4·6	78	2·66
34	11·800	10·800	8·50	2141	2006	$135 = \frac{1}{18}$ E I	3·69	0·11 ,,	59·	62·69	0·45	15·30	4·0	75	2·91
36	12·600	11·600	8·70	2286	2133	$153 = \frac{1}{18}$ E I	4·26	0·12 ,,	59·25	63·51	0·46	16·56	4·3	77	3·10
38	13·300	12·200	8·25	2413	2261	$152 = \frac{1}{17}$ E I	4·00	0·10 ,,	59·50	63·50	0·44	16·72	3·8	74	3·28
40	14·200	12·900	9·15	2567	2380	$187 = \frac{1}{12}$ E I	4·66	0·12 ,,	59·75	64·41	0·46	18·40	3·5	71	3·49
42	15·100	13·600	9·95	2740	2520	$220 = \frac{1}{11}$ E I	5·24	0·13 ,,	60·	65·24	0·47	19·74	3·8	73	3·72

* This column is marked $\frac{E\ I}{g} \times \frac{60}{N}$ in M. Deprez's tables, but as the E of M. Deprez is not the true electromotive force we have preferred to put in its place the expression which he has used for calculating this E.

This numerical table possesses a quite peculiar demonstrative value, because it results strictly from the electric and mechanical measurements taken by M. Deprez during the working of a dynamo, the magnets of which were placed in equilibrium upon knife-edges, so as to permit direct electro-magnetic weighings. There can remain, therefore, no doubt as to the values attributed to the deficiencies and the real electromotive forces.

Our columns 1, 10, 2 are the columns 1, 2, 4 of M. Deprez. The 16 columns of our table are headed with explicit indications and references to the formulæ of which they are the numerical expressions. The only quantities not defined are *c*, a *dynamic* couple, produced by the effort, in kilogrammes by the arm of the lever in metres; R_i, the internal resistance measured statically (at rest); ρ, static external resistances, inert conductors; N, number of revolutions per minute.

This table confirms the reality of the two important secondary effects which we have pointed out and measured; the increase of the effective internal resistance, represented there by a number of ohms or of volts (columns 8 or 9), and the increase of the magnetic-field, when in action, with respect to the static field with the same currents (column 4). The detailed examination of the fluctuations shows to what extent the intervening phenomena are intimately complex. This is an *a posteriori* proof of the importance of considering and elucidating the two dominants which characterise incontestably the totality of the multiple reactions of the magnetic, electro-dynamic and electrostatic orders, of which we have pointed out some, being careful not to declare the list complete.

It is necessary to point out that the author quoted, calculating E by the formula $E = (R_i + \rho)\ I$, naturally finds F smaller than the reality with the expression $F = \frac{E\ I}{V\ g}$; the table proves, in fact, that E is greater than $(R_i + \rho)\ I$. It is from this simple reason that calculation gives him an F smaller than the real value determined by direct weighing when in action.

The author, remarking that these values, which are too small, differ little from the measured effects when the machine is stopped (with the same currents), sees therein a verification of the electric theory of the machines. This, however, at the most, would be merely an agreement proving that in the machine employed the force of the magnetic-field is greater when in motion than when at rest, by these same I, and that this arbitrary diminution introduced by calculating $F = (R_i + \rho)\ \frac{I^2}{V g}$ which depends on the deficiency D, and has the value $\Delta\ F = \frac{D}{V\ g}$ kilos, would approximately agree with the increase which is a function of the augmentation of the increase of the magnetic field in motion.

But suppose that the author takes the same measures and makes the same calculations with a *compensated* machine, arranged so that the magnetic-field does not increase when in motion, taking a given current.

This is possible, as we have shown by proportioning suitably the inducing circulation to the magnetic mass so that it may be sufficiently saturated when at rest. Such a machine will still show a deficiency, and consequently $F = (R_i + \rho)\ \frac{I^2}{V\ g}$ will always be too small.

It will result that F as calculated by this formula will no longer agree with F at rest, which here will be equal to F in motion.

Column 4 shows that if the efforts calculated by the formula $f = \frac{(R_1 + \rho) I^2}{g} \times \frac{60}{N}$ differ little, as the author asserts, from the efforts measured statically, these F will not be always greater than the static efforts by 7 to 10 per cent. only, since, in the first half of the table, $\frac{F - f}{F}$ varies from 10 to 28 per cent. We see here a verification of the fact which we pointed out, that the relative action must be here so much the greater as the mass is less specifically magnetised, and consequently more readily influenced.—*Comptes Rendus.*

THE BELL-DRAWBAUGH TELEPHONE CASE.

WE are indebted to Mr. Johnson, of the New York *Electrical World*, for a set of advanced proofs containing Judge Wallace's decision in the above important legal suit. It is too lengthy to give in full, but the abstract we now publish contains every point of importance. Said the Judge: The action was brought by the American Bell Telephone Company against the People's Telephone Company, and was to enjoin the defendants from using, and furnishing to others for use, the several inventions described in two patents granted to Alexander Graham Bell, of Salem, Massachusetts, being No. 174,465, bearing date March 7th, 1876, for "Improvements in Telegraphy," and No. 186,787, bearing date January 30th, 1877, for "Improvements in Electric Telephony." The issues made by the pleadings are practically resolved into the single question, to which the proofs and arguments of counsel are mainly addressed, whether the patentee Bell, or Daniel Drawbaugh, of Milltown, in Cumberland county, Pennsylvania, was the first inventor of the electric speaking telephone.

The Bell patent has been judicially construed in two cases in the Massachusetts circuit; and in both cases it was substantially held that Bell was the discoverer of the new art of transmitting speech by electricity, and the claim should receive the broadest interpretation to secure to the inventor not the abstract right of sending sounds by telegraph without regard to means, but all means and processes described which are essential to the application of the principle. American Bell Telephone Company *v.* Spencer, 8 Fed. Rep. 509. Same *v.* Dolbear, 5 Fed. Rep. 448.

The defendants contend that long before Bell had perfected his invention, and long before its mental conception by him, Drawbaugh had not only made the same invention, but had perfected improvements in organisation and detail which Bell has never reached, and which were only reached years afterwards by the work of many other inventors in the same field of improvement; and that Drawbaugh, for more than ten years prior to 1880, was miserably poor, in debt, with a large and helpless family dependent upon his daily labour for support, and was from such cause alone utterly unable to patent his said invention or caveat it, or manufacture and introduce it upon the market; and that said Drawbaugh never abandoned his invention nor acknowledged the claims of any other person thereto, but always persisted in his claim to it, and intended to patent it as soon as he could obtain the necessary pecuniary means therefor.

Drawbaugh testifies that he commenced his experiments with the electric telephone as early as 1866; that prior to or as early as in 1867 he had made apparatus (in which he employd a teacup as the body of the instrument) through which speech could be transmitted feebly and incoherently. He testifies that he thinks he made his first telephone apparatus prior to November, 1866, and is positive he had it before he moved his shop to the "Clover Mill" in 1867. As he describes it, the body of the transmitter was a porcelain teacup, the diaphragm was of membrane, the electrodes interposed in the circuit were copper, with the upper one connected to the diaphragm by a wire so as to vary the pressure of a conductor of fine earth or pulverised charcoal through the action of the sound waves, and the receiver was a tin can without a top or bottom, having a membrane diaphragm stretched over one end connected by a tense cord to an armature supported on a spring, and arranged close to the poles of an electro-magnet in the electric circuit. He testifies that subsequently he constructed apparatus upon the same general principle with some change of detail, and he produces exhibits F and B, the former a transmitter and the latter a receiver, as the remnants of the original instruments. Exhibit F is a glass tumbler; and he states that at first he used a membrane diaphragm over it, and then one of thin metal; and that for the conductor he used carbons, or carbons mixed with bronze powder, and used various tops or mouth-pieces to speak into it. The exhibit B, he says, was the receiver, and in this he had discarded the string and the spring of his earlier receiver. He says that experiment led him to improve the transmitter F by substituting a metal diaphragm in place of membrane, and he produces a sketch. A reproduction of this instrument has been made by him for use in the proofs, "which is designated as exhibit F reproduced." In this the mouthpiece is modified in size and in distance from the diaphragm. He made, according to his testimony, a new receiver of more perfect construction, and produces the remnant of the original, which is designated exhibit C. As he describes the instrument it was a decided advance upon the former receiver. In using this he says he tested it also as a transmitter with some success, and then improved it by placing a permanent magnet against the heel of the electro-magnet, and thus made a magnetic telephone. A reproduction of such an instrument as he describes is made and referred to in the proofs as "Exhibit reproduced C." After exhibit C he produces I, A, E, and D, as likewise original instruments made respectively in the chronological order of their production as exhibits. He states that I was used by him as a companion instrument to C. Exhibit A discloses a modification of form and a higher degree of mechanical adaptation. The last two, D and E, are concededly perfect, practical instruments, and according to the testimony of Mr. Benjamin, an expert witness for the defendants, would compete successfully for public patronage with any magneto telephone which had been introduced into use in 1882. It is asserted of these instruments by counsel that no higher development of the telephone has been reached at the present time than is indicated by exhibits E and D. Drawbaugh does not attempt to locate the time at which he made any of these instruments, or even the year. He testifies, however, that he made all of them prior to the time the "Axle Company" commenced business, which was in December, 1874, except D and E, which were made about that time.

The theory of the defendants is, that exhibits F and B were used by Drawbaugh in 1867, 1868, and 1869, exhibit C in 1869 and 1870, exhibit I in 1870 and 1871, exhibit A in 1873 and 1874, and that exhibits E and D were made in January or February, 1875, although cruder instruments essentially similar were made somewhat earlier. It is in proof that 33 patents were granted for improvements in telephones in 1878, 64 in 1879, more than 100 in 1880, and 94 in the first six months of 1881. According to the theory of the defendants, therefore, as early as February, 1875, Drawbaugh had not only distanced Bell in the race of invention, but also Gray and Edison, and had accomplished practically all that has since been done by a host of other inventors.

The complainant starts with the benefit of the presumption of law that Bell, the patentee, was the inventor of that for which the letters patent were granted to him. Whoever alleges the contrary must assume the burden of the proof. Evidence of doubtful probative force will not overthrow the presumption of novelty and originality arising from the grant of letters patent for an invention.

To overthrow this presumption and disprove that Bell was the first inventor the defendants introduce the testimony of nearly 200 witnesses tending to prove the priority of invention by Drawbaugh. As the complainant concedes that exhibits E and D are highly organised practical telephone instruments, and fully capable of perfect articulation, the patents are invalidated if these instruments were in existence at the date of Bell's invention, and as will hereafter appear they were in existence as early as in 1875, or it is incredible that they existed at all until long after Bell's first patent had been granted, and his invention had attracted general public attention at the Centennial Exposition and elsewhere.

The general theory of the defence is substantiated by three classes of witnesses; those who heard of the existence of Drawbaugh's "talking machines" at various times; those who talked through the machines on various occasions, or heard others talk through them; and those who attempt to identify one or more of the exhibits as the instruments they saw or used. Only an outline of their testimony will be given.

More than 50 witnesses testify to having heard of the talking machines prior to February 14th, 1879.

Sixty witnesses do not attempt to identify any particular instrument, but testify that they saw a talking machine, or talked through it or heard it talked through, at Drawbaugh's shop on occasions subsequent to 1867, and most of them fixed the occasion as prior to 1876.

The third class of witnesses are those who identify more or less positively one or more of the several exhibits as the instruments used by them, or which they saw used by others prior to March 7th, 1876. Exhibits F and B are identified by 40 witnesses, and a number of other witnesses saw one of these two exhibits.

The identification of exhibits C, I, and A, is made by a smaller number of witnesses. Some of them think they saw C in 1870, and others at various dates after that, and as late as March, 1876.

One of the witnesses thinks he saw I in 1871, the others locate the occasions in 1873, 1874, and 1875. Some of the witnesses think they saw A as early as 1872, one of them in 1870, but most of them saw it they think in 1875.

Exhibits E and D resemble each other very closely in appearance, and most of the witnesses produced to identify them saw both at the same time. Some of the witnesses who identify exhibits, identify the whole series. Other witnesses besides those named identify one or more of the exhibits as seen by them at times subsequent to the date of Bell's applications for his patent. Some of the witnesses who identify one or more of the instruments exhibited to them by Drawbaugh as the exhibits F, B, or C, saw or used them in 1875 or 1876.

That the talking machines referred to by the witnesses were electric instruments is clearly established. Drawbaugh testifies explicitly that they were always used with a closed circuit and without breaking the current, some of them being battery telephones and some magneto-telephones. He always represented them as actuated by electricity to those to whom he explained or described them, and claimed his invention would supersede the

telegraph. His assertions show them to have been electrical instruments. He stated to the witness, Shauk, "It was the greatest invention ever known. If he had the means to go on with it they could talk, or rather be a time to come as to talk to the old country same as we can talk here"; to Zacharias, that "he could run it out for miles, and parties could talk in at one end and be heard at the other end the same as persons in a room together"; to Smith, that "parties between Harrisburg and Philadelphia could communicate as if they were speaking together," &c., &c.

Thus Drawbaugh is corroborated by a cloud of witnesses whose testimony tends to substantiate his narrative. In order to ascertain what effect is to be given to the corroborative proofs, it is important to determine whether Drawbaugh is an honest witness, or whether he has intentionally falsified collateral facts, and is therefore to be deemed discredited.

If the defence is to be believed, he had been experimenting with his talking machine from 1866, and had successfully transmitted speech as early as 1870, if not before that time. Drawbaugh was well aware of the merit and of the great pecuniary value of the invention; he had obtained patents for several inventions of minor value, yet from 1870, until July, 1880, he did not apply for a patent for the telephone. It was of the first importance to explain the reason of his inaction, because it seems incredible that the inventor of the telephone should not only omit to patent it as soon as he could, but should also remain silent for years after others were winning the fame and profits of the invention. Only one explanation was possible, and that has been attempted. As stated in the answer and in his testimony, it is that he was unable to do so by reason of his poverty, The answer alleges "that for more than ten years prior to 1880 he was miserably poor, and utterly unable to patent his invention or caveat it." He was asked the question: "Do you mean to have it understood from your last answer that there was any other reason for some period prior to 1870, except your poverty, whether greater or less, which prevented you from patenting your invention, or filing a caveat for it?" His answer was: "If I understand that right, there was no other reason, that I can think of now." But it appears that, although it was not convenient at times for him to pay his debts, or he was careless or indifferent, he had not only the means of raising money during all this period, but that on many occasions he had means for investment and for speculation. The pretence that he could not raise the fees to caveat or patent his invention is transparently absurd.

He was accustomed to prepare specifications of patents, and was a maker of models, and advertised himself as an inventor, designer and solicitor of patents. During the time he was experimenting on his talking machine, and before he applied for a patent, he found time and materials for experimenting with and making the Gifford injector for steam engines, the autograph telegraph, the magneto-dial telegraph, the magneto key, the automatic fire-alarm and the electric clock. During this period he was a friend of Mr. Weaver, a patent solicitor, who frequently gave him advice and professional assistance in return for mechanical services rendered by Drawburgh, and who drew specifications for him for a measuring faucet and for the magnetic clock. If he was not competent himself to make an application for the patent, it cannot be doubted that with the assistance of Weaver he could have made a proper application at a trifling outlay, if any, beyond the fees of the office.

In order to fortify the theory of Drawbaugh's inability, from poverty, to patent his invention, the defendants have attempted by testimony from him and from others to show that he was extremely solicitous to patent it, and tried to induce others to furnish the means. Drawbaugh testifies as follows: "Question. A good many witnesses have testified that you were at various times talking of patenting your electric speaking telephone invention; what is your recollection about that, did you intend to patent it or not? Answer. Yes, sir, I intended to patent it. I had spoken to a number of persons to assist me. I would state to them that I would give them an interest in the invention for them to furnish the money to have it patented. Question. Why did you not patent it with your own money? Answer. I did not have any money. Question. At how early a time did you have the intention of patenting it? Answer. I could hardly say how early. I spoke to persons even at an early time. I spoke to Christian Eberly; it may have been prior to 1870 I spoke to Frank Lee; I spoke to them about taking an interest. They were among the earliest. I can't remember all the persons, as I had spoken to a great many." Captain Moore was examined as a witness for the defendants and his testimony is significant. He was the principal of the Soldiers' Orphan School, an institution in the vicinity of Eberly's mills, and was the secretary and treasurer of the Axle Company, a concern that in part occupied Drawbaugh's shop in 1875 and 1876. He testifies that in May, 1875, Drawbaugh showed him a talking machine; said he was unable to patent it himself, and desired witness "to go in with him and get a patent." He states that he told Drawbaugh he didn't want to go into any new inventions, but that it would be a fortune to any person bringing it out if it could be put to practical use. He identifies exhibit B as the machine shown him at that time by Drawbaugh. Although he and Drawbaugh maintained intimate business relations for a year after that time the subject seems never to have been referred to again. Mr. Moore was an intelligent capitalist. It is strange that Drawbaugh should have shown him exhibit B, the crude instrument of 1867-1869, if the perfect instruments E and D were in existence; and more strange that the subject was never mentioned again between them if they had any faith in the value of the invention. Mr. Bayler, the other witness, carried on lumbering and a saw mill from 1873 to 1877 in the vicinity of Milltown, and employed Drawbaugh frequently to repair machinery. He testifies that in June, 1873, Drawbaugh showed him the talking machine, and he said to Drawbaugh, "Why, Dan, that is virtually a talking telegraph," and advised him to take out a patent for it, to which Drawbaugh replied: "If I had the means I would; if you'll advance me the means to procure a patent I'll give you a half interest." The witness continues: "Generally on him meeting me he would urge it, urge me to take an interest by furnishing him the means to take out a patent." He also identifies exhibits F and B as the instruments shown him by Drawbaugh. But his books show that during all the time from April, 1873, to May, 1876, he owed Drawbaugh more than the fees necessary for producing a patent.

It will hereafter be shown that, among the men with whom Drawbaugh maintained business and friendly relations during this period, there were many of intelligence and means. Some of them may have distrusted his judgment and regarded him as a visionary. Some of them may have been indifferent or timid. But it is incredible that, when only a trifling sum was required for a half interest in the invention, none of them could be sufficiently impressed with its merit or financial value to investigate it seriously as a speculation or an investment. Those with whom he is associated in the defence understood fully, and so did he, that the fact that a professional inventor and patentee did not go to the Patent Office to secure an invention like the telephone for ten years after it had been completed and demonstrated was almost conclusive against the theory that he made the invention and that unless this presumption could be parried no court would credit his story. The theory of constraining poverty was therefore formulated in the answer, elaborately fortified by witnesses, and testified to by Drawbaugh. It is overthrown by a few plain, indisputable facts, and Drawbaugh's veracity falls with it.

That he was a skilful and ingenious mechanic is undoubtedly true. Invention was his hobby and his vocation, but that he was an inventor in the large sense is disproved by the nature and results of his work. Every patent that he obtained was for some improvement on existing devices which involved mechanical skill rather than any high degree of inventive faculty.

His own testimony, given in an interference proceeding in the Patent Office in 1869, shows that none of his inventions were sufficiently meritorious to prosper vigorously. That proceeding involved a question of priority of invention between himself and one Hauck, respecting an improvement in a faucet.

When the speaking telephone was first introduced to the attention of the scientific public it was pronounced by one of the most eminent electricians of the day "a result of transcendent scientific interest," and "the greatest by far of all the marvels of the electric telegraph." The inventions attributed to Drawbaugh include not only the conception of the principle of the unbroken, undulatory electric current, and of the delicate and complex instrumentalities essential to its efficient application in transmitting and reproducing articulate speech, but also of many other devices involving a nice adjustment of forces and requiring sensitive mechanism.

It was said by Chief Justice Taney (O'Reilly *v.* Morse, 15 How., III.) speaking of the invention of the telegraph:—"No invention can possibly be made consisting of a combination of different elements of power without a thorough knowledge of the property of each and the mode in which they operate on each other. For no man ever made such an invention without having first obtained this information, unless it was discovered by some fortunate accident." None of Drawbaugh's alleged discoveries were made by accident. His statement is that, starting with the belief that speech could be transmitted by electricity, he made first one contrivance and then another, gradually obviating difficulties and making advances experimentally until he finally perfected the several inventions.

In view of Bell's special equipment for investigation and experiment in electrical and acoustic science, it would not seem strange that his persistent efforts tried to effect the electrical transmission of speech were eventually successful were it not that others as intelligent, as well equipped, as ingenious, and as persevering as he, had devoted years to the same object in vain. And yet had it not been for an accidental discovery made by him in June, 1875, and which would probably have escaped one whose trained faculties were not centered on a careful study of the phenomena, he might have failed.

Drawbaugh, on the other hand, was not only untutored, but he was isolated by his associations and occupations from contact with men of advanced science; he had narrow opportunities for instruction and few incentives for profound research. Among the multitude of his inventive conceptions was one that a talking machine was a possibility. According to the testimony of Lory, a witness for defendants, before Drawbaugh began his practical experiments he exhibited a sketch of a machine that he was about to make that would talk a distance of twenty miles and work something like a telegraph. If this is true, he commenced on his telephone as the architect plans a building or the engineer makes a draught of his structure. His own testimony shows that he did not attempt to qualify himself for electrical inventions by any systematic study after he began experimenting with his talking machine. It is almost incredible that the subtle intellectual discoveries which were a closed book to the ablest electrician could have been reached by a smatterer in science, or by any series of empirical experiments.

He cannot describe what receiver or other apparatus he used with his first transmitter, and testifies:—"I had a number of crude apparatuses, but can't remember exactly the shape of any of them. I had membranes stretched over hoops—over a hoop, I

remember that; and I had electro-magnets, and the arrangement was varied; I don't remember exactly the arrangement." He testifies that when he used the cup machine he used it in a continuous electric circuit, and thinks he used it as a receiver with Exhibit B as a transmitter. He states that he succeeded in transmitting speech with these two instruments, and of course, he could only have done this by employing the unbroken undulatory current of electricity. He cannot state how he conceived the initial ideas of the undulatory current and the continuous circuit, or subsequently the theory of any of the remarkable devices which he produces. His answers to questions intended to elicit such information may be illustrated by giving one of them: "I don't remember how I came to it; I had been experimenting in that direction; I don't remember of getting at it by accident either; I don't remember of anyone telling me of it; I don't suppose anyone told me." It seems little short of the miraculous that a man of his capacity and equipment should have produced these inventions at all; more marvellous still that he should have produced them without any intellectual perception of his discoveries.

If no honest and reasonable explanation can be given for his conduct, the inference is very strong that he knew he did not have a practical telephone to patent. He may have had a talking machine which was well calculated to excite the curiosity of the community in which he lived; he may have indulged in expectations that in time he could succeed in making a practical speaking telephone, and reap fame and profit from it, but his conduct is almost decisive against the supposition that he had even deluded himself with the belief that he had produced anything sufficiently practical and valuable to patent. He never attempted to exhibit it outside of his own shop to prove that it would transmit speech at a distance of even a quarter of a mile. The proofs show that during all the years from 1867 to 1873 he did not attempt to avail himself of opportunities for demonstrating his invention and bringing it to the notice of friends who were peculiarly qualified to appreciate, and were favourably circumstanced to assist him. From 1867 to July, 1873, Drawbaugh was intimately connected with the persons composing the Drawbaugh Manufacturing Company, which was engaged in manufacturing devices under Drawbaugh's patents. He was a stockholder and the master mechanic of this company. Among the officers and stockholders were many men of capital and enterprise. There came a time when the managers of the company wanted Drawbaugh to suggest new devices for the company to manufacture. He never suggested the telephone, nor attempted to induce the managers of that company to investigate or exhibit his talking machine. A number of the managers and employés of this concern testify that they never heard of the existence of the talking machine during the life of the company. Without attempting to refer to other testimony to the same general effect, what has already been referred to shows that if Drawbaugh had seriously desired to bring his talking machine into public notice, and secure the fruits of his invention, he had ample opportunity to do so. Who can doubt that if he had a practical telephone to exhibit he would have selected just such men as Kiefer, Wilson, and the others to demonstrate it to them, and enlist them to demonstrate its utility and value to the public.

In 1874-6 Drawbaugh issued a business card advertising himself as "inventor, designer, and solicitor of patents." On the back of this card is printed a list of his inventions, but the omission to mention the most important one of all of his inventions, one respecting which, according to his present testimony, there had not been a week from the time he made his first cup machines that he had not been engaged with it, one which was complete before his electric clock was complete, is a significant statement by implication that he had no such invention to advertise.

It is to be remembered that when he chronicled his achievements in the autobiographical sketch of 1878, the Bell telephone had been introduced into commercial use at Harrisburg, three miles from Drawbaugh's shop, and the local newspapers had been full of the subject.

During the time in question Drawbaugh had friendly relations with the newspapers of the vicinity; his friends were frequently communicating laudatory notices of his mechanical and inventive efforts to the press, and he himself visited one of the newspaper offices in the spring of 1878 to show a telephone he had made. These newspapers had published articles about the Bell telephone, but up to the spring of 1878, while many notices had been published in them about his electric clock and other inventions, describing him as a man of extraordinary genius, there had been no mention of the telephone, and when, in the spring of 1878, the subject was mentioned, he was referred to as one who was "inventing a telephone on a different plan from that now occupying the attention of the scientists," and as about completing the new telephone he is now constructing.

It remains to consider what effect is to be given to the testimony of the multitude of witnesses who have been produced to substantiate the defence.

Disregarding the testimony which is merely hearsay, and therefore incompetent as evidence of the main fact, the testimony of many other witnesses is overthrown by the palpable improbability of their statements, or by the contradictions between their statements and those of other witnesses for the defendants upon substantive points, or by successful attacks upon their accuracy in the rebutting testimony of the complainant.

There still remains a formidable number of witnesses who testify to seeing or using Drawbaugh's talking machine, and some of whom identify particular exhibits as the instruments which they saw or tried.

No doubt is entertained that Drawbaugh was experimenting at an early period with telephones or phonographs. Prior to 1869 Dr. Van Der Weyde had made public experiments with the Reis telephone at the City of New York, and others had made like experiments elsewhere. In May, 1869, a full description of the instrument and of the experiments was published in the newspaper *The Manufacturer and Builder*, treating it as a highly interesting curiosity, which contained the germ of great practical purposes. Whether other newspapers noticed the experiments or not is not shown, nor is it shown that Drawbaugh saw the article in *The Manufacturer and Builder*. As is stated by Mr. Benjamin, it has been asserted of the Reis instrument that certain sounds of the human voice can be transmitted by it, but in truth these are merely fragmentary reproductions of vocal sounds, and the transmission of articulate speech could not be effected because it was constructed on the make-and-break principle, instead of on that of the undulatory, unbroken current.

It is not strange to any reader of the autobiography that Drawbaugh should have taken up the telephone. That he and those about him should have treated it as a talking machine is entirely natural. That his talking machine as late as in 1876 bore a striking resemblance to the Reis telephone is shown by Mr. Shapley's testimony, a witness who noticed the resemblance, and loaned Drawbaugh a copy of the *Scientific American* describing it.

There is enough here to explain Drawbaugh's declarations to his neighbours about the talking machine he was inventing, and to excite the curiosity of the community. When witnesses undertake (as many of them do) to give the exact word or sentence heard in the instrument five or ten years before, when their attention was not called to the subject afterwards, no hesitation is felt in rejecting such statements as utterly incredible. If Drawbaugh was a charlatan he may have assisted in deluding them, and the proofs show that between 1872 and 1874 a string telephone was in his brother's shop, in the village. The fact that he never attempted to exhibit his machine outside of his shop, where it could be used between points some considerable distance apart, and where its real capacity could be readily observed, is significant in this connection.

The more important testimony is that by which it is sought to identify the several exhibits, and show their existence at times consistent with theory of the natural evolution of the invention. Such witnesses could not appreciate what they saw even if they examined the instruments. Exhibits F, B, and C are fragmentary remains of instruments, and their value depends upon Drawbaugh's description of the operative parts that no longer exist. Scores of witnesses testify to seeing the teacup device resembling exhibit F, and the tin can device resembling exhibit B, but the identification of the other exhibits prior to the date of Bell's patent is comparatively feeble.

The appearance of exhibits F, B, and C is sufficiently peculiar and distinctive to impress the memory of those who saw them. On the other hand, the other exhibits are not of this character, and all that ordinarily the witnesses can safely say of them is that five years or more before testifying they think they saw or used a small walnut box externally resembling I or A or E or D.

It may be said generally of all the testimony of the witnesses who attempt to identify exhibits, that it is mainly valuable when it proceeds from those who used the instruments which they think they remember, and obtained results. They must remember the results obtained much better that the minor differences of appearance presented by the instruments. Granting that exhibits F, B, and C, would be likely to be remembered, what shall be said of the value of the testimony of scores of witnesses who state that they tested these instruments, or saw others test them, and they articulated perfectly, when it appears by the most authentic test that these instruments were incapable of such articulation?

In March, 1882, after most of the proofs in the case had been taken, a test was made of the capacity of the exhibits to transmit speech in the presence of the counsel and the experts for the respective parties. It is not accurate to say a test was made of the exhibits, but reproductions of F, B, and C, were made by Drawbaugh, and as rehabilitated by him, were used for the test. Whether these were honest reproductions, no one can tell; but such as they were they were experimented with by Drawbaugh before they were subjected to the test. Whatever else that test demonstrated, it proved that articulate speech could not have been practically communicated through exhibits F, B, and C, at Drawbaugh's shop, or under similar conditions; and that only fragmentary or incoherent speech could be occasionally and exceptionally rendered by the reproduced instruments which had been experimented with privately before the public test. The proofs show that all along to 1878 Drawbaugh exhibited his earlier instruments F and B to spectators, and used them as his talking machine, sometimes showing or using both together, and sometimes one of them. How is it to be explained that he used these crude instruments in 1875 and 1876 as his talking machine if he had the better instruments, especially such instruments as E and D. But in view of the fact now shown that these earlier exhibits are incapable of satisfactory articulation, what confidence can be placed in the rest of the testimony produced to identify exhibits? And the reasonable explanation of their testimony is that those witnesses who really saw or used the latter exhibits did so in 1876, 1877, 1878, and later, instead of on earlier occasions.

The proofs on both sides lead to general conclusions that Drawbaugh was not an original inventor of the speaking telephone, but had been an experimenter without obtaining practical results until the introduction of the instruments into Harrisburg. It is very probable that after reading in the *Scientific American*, loaned

by Mr. Shapley in October, 1876, the article purporting to describe Bell's telephone, but which really described better the Reis apparatus, he undertook to improve his old devices. At that time, or after, he had examined the telephone instruments at Harrisburg and carried one of them home to study; he may have altered the organisation of his instrument, and made the intermediate exhibits between F and D. If he exhibited them at his shop, and was able to transmit speech through them, this fact will account for the testimony of the witnesses who identify those exhibits, and may be mistaken as to the time they saw them. The real history of his talking machine is known only to himself, and will not be profitable to conjecture when he made the advanced instruments which he claims to have made in February, 1875, and the later instruments.

Succinctly stated most favourably for the defendants the case is this: One hundred witnesses more or less testify that on one or more occasions, which took place from five to ten years before, they think they saw this or that device used as a talking machine; they are ignorant of the principle and of the mechanical construction of the instruments, but they heard speech through them perfectly well, and through one set of instruments as well as the other. This case is met on the part of the complainants by proof that the instruments which most of the witnesses think they saw and heard through, were incapable of being heard through in the manner described by them; and, further, that the man who knew all about the capacity of his instruments never attempted to use them in a manner which would demonstrate their efficiency and commercial value; and, on the contrary, for ten years after he could have patented them, and for five years after they were mechanically perfect, knowing all the time that a fortune awaited the patentee, and with no obstacles in his way, did not move, but calmly saw another obtain a patent and reap the fame and profit of the invention.

Without regard to other features of this case, it is sufficient to say that the defence is not established so as to remove a fair doubt of its truth; and such doubt is fatal.

The observation of an eminent commentator may be quoted as apposite to the case: "No form of judicial evidence is infallible, however strong in itself; the degree of assurance resulting from it amounts only to an infinitely high degree of probability, and perhaps as many erroneous judgments have taken place on false or mistaken direct testimony as on presumptive proof." Best's Evidence, sec. 468.

A decree is ordered for complainant.

NOTES.

To Our Readers.—Next week being Christmas week, the ELECTRICAL REVIEW will be published at mid-day on Wednesday, the 24th instant. After that date the offices of the REVIEW will be closed until Monday, the 29th of December.

Electric Lighting.—On Monday evening last a very good exhibition of incandescence electric lighting was shown at Mr. Hammond's residence at Highgate. A 6-horse power gas engine of Crossley's manufacture was employed to drive a No. 5 "Ferranti" alternating current dynamo—the fifth machine of this invention ever constructed—excited by a small Siemens machine. The lamps (80 in number) were of the Swan pattern, of about 12-candle power each, and they have been in continuous use without replacement for about two years. The fittings were of a very artistic design, and a special arrangement of sliding resistances was shown in the dining-room to facilitate the regulation of the light.

On the occasion of the popular lectures given recently by Mr. Eric Bruce, at the Crystal Palace, Kensington Assembly Rooms, Grosvenor Hall, and other places, the stage was lit by means of the Electrical Power Storage Company's cells, which also furnished the current for the experiments.

The Glasgow Post Office is about to give the electric light an extended trial. The contract with the old company having expired, another company is to have an opportunity of showing what may be done in the way of electrically lighting large buildings. All the old wires which run along the walls and ceilings, and which are not very sightly, are to be taken down, and new conductors put under the floor. The engines and dynamo machines, at present in the basement of the building, are to be removed to a station outside the post office building. The contract, we understand, is for five years.

On Friday week experiments were made at Hawick with a view of ascertaining the adaptability of the electric light for street illumination. Messrs. Anderson & Munro, Glasgow, fitted up the lamps, which burned very steadily, and proved superior to the gas lamps in the vicinity. The experiments were considered successful. The decision of the Town Council is not yet known. The motive power was obtained from Messrs. Elliot & Son's factory.

Peru seems slightly in advance of some other countries, for its Government has just arranged to have the principal cities lit by electricity. Coal is very costly in the Peruvian Republic, and Lima and Callao are the only places that have been lighted with gas, while all others have depended on kerosene lamps. In most of the cities the electricity will be generated by means of running water, and the expense will thereby be marvellously reduced.

Big possibilities are said to await the electric light in the Southern States of America, where already this year fire has destroyed over $250,000 worth of cotton in ginning houses. The shreds of inflammable and combustible material flying round in these houses render it extremely dangerous to use lamps, candles, or other exposed flame, for light. This necessarily cuts the safe working day very short. In the rush to get to market, enterprise often tempts the planter to risk which the enclosed electric arc will remove—making night work possible with safety.

The river steamer *Pargoud*, recently built at Howard's yard, Louisville, Kentucky, has been fitted up with arc and incandescent lamps, having an ocean projector at her bow. The United States Company's system is used, with two dynamos driven by a Buckeye automatic engine.

The contract for the electric lighting of part of the Schaerbeek Station, near Brussels, will be let at the Bourse du Commerce, Brussels, on the 24th December, 1884.

A portion of the Government Hospital in Christiania has been fitted with the electric light, by Messrs. Paterson & Cooper; and so successful is it considered, that a large extension of the light will probably very soon take place. This firm has also fitted, through their agents in Norway, the Devolds Wool and Weaving Mill, the Gjethus Paper Mill, Nilsen and Mathiesen's Saw Mills, the Hœgholmens Shipyard, and the Rusclok Bahkens Bazaar.

Messrs. Paterson & Cooper have also orders to fit up Messrs. Halstead & Co.'s Mills, near Bradford. Amongst other installations completed, or in course of completion, by this firm in that neighbourhood are Messrs. Michael Theard & Sons, of Batley; Messrs. Stubley & Co., Batley; J. L. Stewart & Co., Valley Mills, near Bradford; Reuben Gaunt & Sons, Farsley; Kessler & Co., Vicar Lane, Bradford; J. Bannister & Sons, Leeds; and A. and S. Henry & Co., Bradford.

The Gülcher Electric Light and Power Company has secured the contract for lighting the Alexandra Palace.

We have received a copy of the prospectus of the House and General Electric Lighting Company, Limited. It has been formed for the purpose of acquiring and working the primary battery of Mr. Theophilus Coad; and, although this will be made a special feature in the electric lighting operations of the company, it will be prepared to carry out large installations by means of dynamo machinery, &c. The "certificates of efficiency" of the Coad voltaic battery, which is, we are told, a modification of the Bunsen, appear to possess as much value as the paper they were written on. Thus, two gentlemen whose names we do not recognise as having any weight in the electrical world, report as follows: "This is to certify that the battery (six cells) gave a perfectly steady and efficient light to an incandescent lamp for 49 hours." Two eminent professors also report that the battery gives a fairly steady current of 4 ampères. To make the tests

complete, we will add that one cell would probably give a deflection of x degrees on a lineman's detector; this last observation being quite as valuable and definite as those going before. Should we be able to get any reliable data respecting the Coad battery, we will not fail to bring it before the notice of our readers; indeed, if the company will favour us with a cell we would willingly test it, and publish the results in the REVIEW. In the meantime, may the House and General Electric Lighting Company go on and do good work.

A representative of the *Pall Mall Gazette* has interviewed Dr. J. A. Fleming and elicited his views upon electric lighting in America, which are given to the world in Thursday's issue of our enterprising contemporary. Dr. Fleming attended the meeting of the British Association at Montreal, and afterwards spent some time in the States; he gives information of pretty much the same kind as that contained in Mr. Preece's recent lecture, and is able, moreover, to state some further facts as to the working of the Edison Company. Regarding a question of interest just now, he says that when he described to Mr. Edison the legislative trammels under which electric illumination in England labours, the eminent inventor exclaimed, "Why, they have throttled it!"

Printing by Electricity.—With regard to the cost of running his large printing establishment by electricity, Mr. Geo. S. Merrill, the proprietor of the Lawrence (Mass.) *American*, says:—"We formerly used a Baxter 10 horse-power engine, necessitating the employment of an engineer, but the employment of the Edison company's power gives a saving in expense of more than 33 per cent. The speed is uniform, and the power satisfactory in every respect."

Telephonic.—Messrs. Tasker, Sons & Co., of Sheffield, have received from the Lord Chamberlain the appointment of Telephone Engineers to the Queen, in recognition of the satisfactory nature of the telephone work recently done by them at Balmoral, Abergeldie, Ballater, and Windsor.

Telephony in Scotland.—The Grangemouth merchant traders have arranged with the National Telephone Company for telephonic communication with Glasgow, Bo'ness, and Falkirk.

The Bell-Drawbaugh Case.—We give in our other columns the decision of Judge Wallace, of the United States Circuit Court for the Southern District of New York, in the suit of the American Bell Telephone Company against the People's Telephone Company. The decision, says the New York *Electrical World*, is one of the most important ever rendered in any case in America, and brings to a close litigation that has extended over four years. The interests involved cannot at the present time be worth less than $100,000,000, while it is impossible to calculate any limits to the growth of the telephone business during the full lifetime of the Bell patents. The case appears to have been fought on both sides in a determined manner, without regard to expense. Some of the results of the decision have already been experienced. It is said that the case will be appealed to the Supreme Court, but an appeal of that kind in such a case involves only remote contingencies. The stock of the parent Bell Company and its offspring has bounded upward, and that of the former will probably stay above 250. Less than six months ago it went below 150! One effect of the decision will be the discouragement of further telephone litigation, although it is noteworthy that the McDonough claims are to be actively pushed in the teeth of this greatest victory of the Bell patents. Another effect is that the telephone business will improve. The outlook has been much brighter throughout the week, and telephonists generally (states our contemporary) say that, now the uncertainty has been removed, affairs are on the mend. The subscribers may still feel the pinch of dull times; but the telephone companies, secure in their position, will work with greater vigour, and thus secure larger patronage.

Disadvantages of Telephone Call Offices.—The following letter from a subscriber to the Edinburgh Exchange places the question of public call offices in a new light:—"The telephone companies appear to propose opening places of call where any person off the street may for a trifling payment—a penny is suggested in some cases—ring up any subscriber, and insist on holding a conversation with him. I do not think the subscribers have been consulted about this, and to me it seems so very objectionable that, convenient as the telephone is in some respects, there may be a balance of advantages in favour of ceasing to subscribe. Even as things are, the considerations are not all on one side. Whatever you are engaged in must be interrupted to attend to some one speaking through the telephone, although if he appeared in person he might have no claim to such prompt and exclusive attention. Then there are persons who insist on discussing important matters of business through this medium, which, at the best, involves a hurried and indistinct conversation, and considerable difficulty in the way of a trustworthy record of what has passed. Subscribers have the security at present that none but subscribers can address them in this way, and that these are equally interested in the telephone not becoming a nuisance; but if everybody who has a penny or threepence to spare can insist on being listened to by any of the leading business establishments in a city, we shall only be able to protect ourselves against triflers and intruders by paying less regard to all telephone communications. I hope the project will be reconsidered."

The Telephone Cases in America.—The controversy between the telephone companies assumed a new and definite shape on the 26th ult. by the filing of a bill in equity by the United States Telephone Manufacturing Company against the American Bell Telephone Company and the Bell Telephone Company of Philadelphia, in the United States Circuit Court. Mr. Jerome Carty is solicitor for the complainants, and Gen. S. A. Duncan and the law firm of Alexander & Green, of New York, are their counsel. In discussing the questions at issue, Mr. Carty said that the bill just filed was one of a series, growing out of the protracted controversy since 1878 in the Patent Office between James W. McDonough and A. Graham Bell, on the question of priority of invention of the receiver now in use by the Bell Company. These cases transfer the right from the Patent Office to the courts. The evidence in the Patent Office on which the examiner originally awarded priority to McDonough, fixes the date of May, 1875, as the date of McDonough's invention, and July, 1875, as the earliest date as to Bell. As to the legal status of the telephone and the probable result of the case pending, Mr. Carty said: "The legal status of the telephone has been purposely complicated and rendered obscure to obtain time and delay by the shrewd and adroit management of the Bell people, both in the Patent Office at Washington and in the Courts of the United States, by covering the true issue of mechanical construction and invention under the specious and disingenuous fifth claim of Bell's first patent of 1876 as applied to multiple telegraphy. That claim is that Bell was the discoverer of the method of causing electrical undulations similar in form to the vibrations of the air accompanying vocal or other sounds. This is the substance of the now celebrated fifth claim, known as 'the undulatory current claim,' on which Mr. Bell poses before the world as an inventor of the articulating telephone, and by which a huge monopoly has clutched the telephone by the throat, and throttles and strangles all competition and opposition, and hinders improvement. The Drawbaugh case," continued Mr. Carty, in answer to a question, "only involves the question of transferring the unsuspecting and innocent public from one monopoly to another, because the

question involved under the pleadings is one of priority alone—that is, whether Drawbaugh or Bell is entitled to the monopoly as the inventor or discoverer of the so-called undulatory current, without regard to any form of current." "What is the difference in the legal status between England and the United States on the Bell patent?" Mr. Carty was asked. "As to the broad claim of the undulatory current, the English courts are five years further advanced in the hammering out of the true status of the claims of Mr. Bell than our courts in the United States. In the English case of The United Company *v.* Harrison, Cox-Walker & Co., the Bell patent is limited to the mechanical construction of the apparatus as improved in his patent of 1877 of a permanent or electro magnet in combination with a plate or armature capable of inductive action. That is the means or apparatus which produces an effect or result, namely, articulate speech by mechanical means, and not a claim to the broad principle of the effect and result by electricity as supported in the United States without regard to the apparatus or mechanical means of producing it. As to the probable outcome of the litigation, Mr. Carty was chary of expressing an opinion. "It is dependent upon the delays of litigation," he said, "especially where the interests involved are so large, and backed up by such powerful influences as the Bell Company. Could, however, a case be brought before the Supreme Court of the United States involving the broad question, the ultimate effect must be to relegate Mr. Bell and his invention to the exact status which it should occupy, and that is as an improvement upon what was known before, and which rendered the production of articulate speech by electricity possible, and that is a permanent or electro-magnet in combination with a plate or armature capable of inductive action, and it would therefore follow that the converse of this proposition would be true, that the combination of a plate not capable of inductive action with a magnet or with an electro-magnet, would not fall within Bell's patents, and there are several such instruments in existence in England and in the United States, but they are covered by the broad fifth claim. This litigation," said Mr. Carty, in conclusion, "is identical with that which preceded the free use of electro-magnetism as applied to the telegraph. The eighth claim of Morse's patent was held to be invalid, because it was regarded by the court as being not for a process, but for a mere principle. Justice Bradley, in the case of Tilghman *v.* Cooper, quoting Lord Chief Justice Campbell, said the claim was for the exclusive right to the use of electro-magnetism as a motive power for making intelligible marks at a distance; that is, the exclusive use of one of the powers of nature for a particular purpose. It was not a claim of any particular machinery, nor a claim of any particular process for utilising the power, but a claim of the power itself, a claim put forward on the ground that the patentee was the first to discover that it could be thus employed. This claim the court held could not be sustained. It was too broad and not warranted by law. The plain language of this decision in this court seems entirely to have been overlooked or ignored, and the cases thus far decided in favour of Bell. These are the general grounds on which the plaintiffs in the cases already commenced and far advanced place their rights and mean to rely, and press forward to as early a conclusion as possible, irrespective of the facts disclosed by the evidence that McDonough was the first to construct a receiver containing a magnet in combination with an inductive plate."

A Telephone Exchange in the West Indies.—Port of Spain is jubilant at the prospect of a telephone exchange. The *New Era* says it will, no doubt, be a welcome piece of news to the numerous subscribers who are pledged to support the new undertaking prompted by Mr. A. W. Gray, to learn that the movement is now placed beyond the pale of mere speculation. It is fully expected that the system will be in operation in the early part of January.

The Telephone in a Chapel.—Preparations are being made with a view to effecting telephonic connections with the plattorm of Dr. Talmage's tabernacle in Brooklyn, so that subscribers in his parish may listen to his sermons in the seclusion of their homes.

The Commercial Cable Company.—The *Financial News*, which is usually well informed on American matters, understands that the delay in the commencement of operations by the new Cable Company is due to a serious disagreement between Mr. Bennett and Mr. Mackay, the promoters of the enterprise; and that it is not improbable that Mr. Mackay may sever his connection with the company altogether.

The Mackay-Bennett Cable.—The second Mackay-Bennett cable, which was broken several weeks ago, has been picked up by the steamship *Faraday*. The weather is unfavourable for repairing operations at present, and the necessary work to restore telegraphic communication can scarcely be effected until the weather moderates.

Telegraphic Communication at Sea.—The proposed experiment with a telegraph cable between a lightship and the shore is now being carried out, telegraphic communication having been established between the Sunk Light Vessel and Walton-on-the-Naze, a distance of about nine miles. Not only are the Morse and Wheatstone instruments working efficiently between these two points, but the telephone, which it was feared the noise at the lightship would have interfered with, is a complete success. Either by day or night the lifeboats can now be called from Walton, Harwich, or Ramsgate to any casualties which may occur in the neighbourhood of the Sunk Light, which lies in the centre of a large group of dangerous and well-known sands. As these sands are at times the scenes of disasters, and as the crew of the Sunk can see rockets fired as wreck signals from other outlying lightships, it is hoped that a great saving of life and property at sea will be effected by the system now established, although for a time it will be well to view it only in the light of an experiment. The work has been carried out by the Telegraph Construction and Maintenance Company, Limited, under the immediate supervision and with the assistance of the Elder Brethren of the Trinity House and their engineer-in-chief. The mode of taking the telegraph cable into the lightship so as to avoid as much as possible all risk of its fouling the vessel's moorings is an alteration in detail of the plan originally proposed and illustrated by the model shown at the Fisheries Exhibition, and has involved the substitution of a length of steel wire cable, of which the telegraph cable forms the core, for the double-linked chain cable within which it was intended that the telegraph cable should lie. Notwithstanding the unfavourable weather just experienced, all the details of the enterprise have been carried out in a satisfactory manner.

Sixpenny Telegrams.—In view of the greater influx of messages consequent upon the adoption of the cheaper rate of telegraphing in August next, the electrical department of the post-office has been and is now adding and extending a large number of new wires throughout the metropolis and the provinces to meet the expected increase in telegraphic work. In London, notably in the Paddington district, along the Uxbridge-road and other main thoroughfares, the wires have been placed in iron piping and laid under-ground, it being the intention of the authorities to do away, as far as practically can be done, with all overhead wires, and the pneumatic tubing now so successfully carried on between the London central telegraph office and the city offices (when removed from the upper galleries of central office to the ground floor) will, it is anticipated, be extended to the various district offices throughout the metropolis, thus enabling the department to monopolise the wires in present use of these offices, about 12 in all, to another account.

A Cable to Mauritius.—The French Government have contracted for the laying of a cable from Zanzibar to Mayotte, Nossi Bé, St. Mary's, and Tamatave. It is to be completed in June next. The company will continue the cable to Réunion and Mauritius.

The ss. "Silvertown."—This cable vessel left St. Louis on the afternoon of the 14th inst. She was expected to arrive at Teneriffe on Thursday last, and at Lisbon on Tuesday. The St. Louis land-line is completed.

Glasgow Fire Alarms.—Arrangements are being carried out at Glasgow to improve the fire alarms system. Formerly, when an alarm of fire was communicated to a district police office by an electric apparatus from a street corner, it was necessary in telegraphing the information to the central fire station in College Street to give the name of the locality from which the alarm had been received. The various alarms have now been numbered, so that fewer words suffice in apprising the central brigade. Thus an appreciable space of time is saved, and that, it will be admitted, is of the utmost importance, the value of seconds during the early stages of a fire to those who essay its extinction being incalculable.

"Playing with Fire."—If (the *Globe* says), as the magistrate at Worship Street believes, there is no punishment for giving a false alarm of fire by means of the telegraph posts now set up in the streets beyond liability to pay for the broken glass, it is high time there should be. Each false alarm brings out 30 fire-engines, 100 men, and 20 escapes, and when such a joke as this can be enjoyed at the possible cost of fourpence, we are not surprised to learn that it is frequently played. No doubt it is desirable that our firemen should be kept on the alert, but this is better left to the responsible authorities.

The Boston Electrical Exhibition.—The New York *Electrician* says, with regard to this Exhibition, that while a very creditable exhibit will be made, it is to be regretted that there is some doubt as to whether the prominent exhibitors at Philadelphia will repeat there. The Edison people have but just decided to come, probably with a much reduced display; the American Bell Telephone Company is not fully determined, but will probably make a small exhibit—and others in the same proportion.

International Inventions Exhibition.—With a view to giving further protection to the inventions of exhibitors, a new certificate has been granted by the Board of Trade to the effect that "The International Inventions Exhibition, proposed to be held at South Kensington, S.W., in the county of Middlesex, from the 1st day of March, 1885, is an international exhibition," and by this means all the protection accorded from the 1st of May, to inventions under the original certificate (dated August 15th), will be secured in addition from the 1st of March till the 1st of May, *i.e.*, during the time in which the exhibits will be received and arranged. A printed copy of the extracts from the Patents, Designs, and Trades Marks Acts, 1883, bearing on this subject, may be obtained on application to the secretary, International Inventions Exhibition.

The "Monthly Correspondent."—This little journal, which has already been mentioned by us as hailing from Madeira, has just completed its first year. It was started chiefly as a convenient channel of information relating to subjects of general or particular interest to the staffs of the various stations of the B. S. T. Company, and to report the incidental news of the various stations. We believe that its promoters have worthily attained the objects at which they aimed, and we shall heartily welcome the *M. C.* in the new year. We ourselves have derived considerable pleasure in perusing its contents, and we trust the venture will receive the support it so well deserves.

Electrifying Milk.—A correspondent of the *Standard* states that he repeatedly saw the late Mr. Andrew Crosse, in his laboratory at Fyne Court, make experiments in subjecting milk to electric action, whereby it was kept sweet for weeks together. In the "Memorials of Andrew Crosse," p. 219, the very simple arrangement is described:—"Two cylinders of sheet zinc and sheet iron are severally placed in two porous earthenware tubes, open at the top, closed at the bottom, the same being filled with water . . . and connected at the top by a copper riband . . . The earthenware vessels are placed in the fluid (milk or other), and the electrical action immediately commences, and the fluid becomes antiseptic in a few hours." "Milk has been kept sweet for three weeks by this process in the middle of summer," p. 221.

British Association.—At the close of the British Association Meeting at Montreal, the suggestion was brought forward that it would be a graceful act to form a fund for the purpose of founding a gold medal, to be given annually, in the Faculty of Applied Science, at the McGill University at Montreal. A sum amounting at present to £540 has been subscribed. Deducting the necessary expenses of printing and postage, there will remain an amount of something over £500 to provide the medal. The General Committee of the Association has agreed to provide from the funds of the Association sufficient for the purchase of a die, so that the interest resulting annually from the investment of the whole of the above amount may be available for the medal itself. The honorary secretaries will be glad to receive contributions from any members of the Association who may not yet have subscribed. These may be sent to them at the Society of Arts' House, John Street, Adelphi; or may be paid in to the account of the fund, at Messrs. Hoare, 37, Fleet Street.

Lighthouse Illuminants.—Professor Tyndall, in a letter to the *Times*, maintains that the experiments in lighthouse illumination at South Foreland, which Captain Webb, Secretary to the Elder Brethren of the Trinity House, has stated will shortly be brought to a conclusion, should be continued throughout the winter, so that the merits of the respective lights in penetrating fogs may be more amply tested.

Alternating Current Machines.—In the very interesting and complete paper read by Mr. H. Wilde before the Literary and Philosophical Society of Manchester in 1868 (see ELECTRICAL REVIEW for the 29th ult.), reference was made to a letter received by the author, two years prior to his lecture, from Mr. Farmer, of Salem, Mass., U.S. America. Mr. Wilde has kindly forwarded to us the postscript attached to that letter for publication. It runs thus:—

"Salem., Mass., U.S.A.
"H. Wilde, Esq. "November 9th, 1866.

. . . . . .

"P.S.—Allow me to add that I have built a small machine in which a current from the thermo battery excites the electro-magnet of your machine to start it, and after the machine is in action, a branch from the current of the magneto passes through its own electro-magnet, and thus supplies the magnetism required. It is not exactly like a person standing in a basket and trying to lift himself, because the electricity proceeds from the conversion of the mechanical energy, which must be continually supplied; neither can it in any way be likened to the various schemes for producing perpetual motion, but depends on the principle that the actual energy of the mechanical power, conjointly with the potential energy of the magnet, can develop a greater amount of potential energy than is originally resident in the magnet; or, in other words, it is a method of converting part of the actual energy of the prime mover into the potential energy of magnetism. . . . "M. G. F."

Mechanical Characteristics of Lightning Strokes.—At the first monthly meeting of the session of the Royal Meteorological Society, Colonel the Hon. Arthur Parnell read a paper on "The Mechanical Characteristics of Lightning Strokes." The main objects of this paper were—first, to attempt to show that lightning is not a sort of electric fluid that descends from the clouds, injures buildings and persons in its course, and dissipates itself in the earth, but that it is a luminous manifestation of the explosion caused by two equal forces springing towards each other simultaneously from the earth and the under surface of the inducing cloud, and coalescing or flying out nearly midway between the two plates of the electrical condenser formed by the earth and the cloud; secondly, to demonstrate that of these two forces it is the earth-spring or upward force alone that injures buildings, persons, or other objects on the earth's surface, and that constitutes tangibly what is rightly known as a lightning stroke. The author gave the details of 278 instances, the records of which were intended to demonstrate with more or less precision the existence of an upward direction in the force of the stroke.

Underground Conductors.—The Philadelphia Sectional Conduit Company is, says the New York *Electrician*, having a little difficulty of rather a dangerous character. Within the past two months several explosions have occurred in the trench where its system is laid, owing to the accumulation of foul air, gas, &c. When the explosions occur, the heavy iron coverings of the manholes are lifted high in the air, and should they happen to strike anyone in their ascent or descent it would very likely prove fatal. It can readily be imagined how dangerous these explosions are when they generally take place on one of our most crowded and narrow thoroughfares — Chestnut Street. It is to be hoped that the gentlemen connected with the system will soon find a remedy for this evil.

Gülcher Electric Light and Power Company, Limited.—The petition presented by Mr. J. Norton for the winding up of this company was dismissed last Saturday by Mr. Justice Chitty upon terms that the costs should abide the result of an action; and the petition presented by Mr. Henry Crookes and others, with a similar object, was also dismissed upon terms of paying the petitioners' debt and costs. Writing to the *Times* upon the subject of these actions, Mr. De Castro, chairman of the company, states:—"The Gülcher Electric Light and Power Company, Limited, has this day concluded a contract for lighting the Alexandra Palace with the electric light. This contract would have been signed a fortnight ago but for the two petitions to wind up the company which have been hanging over this company for the last month, and were only dismissed on Saturday. The case affords a striking instance of the extent to which a joint-stock company's business may be paralysed by petitions of the kind. The tender for the above contract was accepted by the Palace Company on the 1st of December instant, subject to our getting the petitions dismissed on the following Saturday. On Saturday, the 6th inst., they were allowed by the judge to stand over for a week. By dint of great pressure the Palace Company were induced to keep the contract open for another week, but they distinctly warned us that under no circumstances could they keep it open beyond to-day (December 15th). On Saturday last the first petition (Mr. Norton's) came on, and lasted until the rising of the court, when it was dismissed upon terms. As an action is now pending by the company against Mr. Norton and others affecting the fees claimed by him it would be improper to criticise this petition. With regard to the other (Mr. Crookes's) it was about to stand over for another week, and the alternative presented to this company was either to pay this disputed claim or to throw up the Alexandra Palace contract. Under the above circumstances, and only under the above circumstances, the company elected to pay Mr. Crookes and his solicitors' costs, and get this petition also dismissed."

The Hammond Electrical Engineering College.—Last week a well attended *conversazione* was held at the Hammond Electrical Engineering College in Red Lion Square, Holborn. There was a large display of electrical and scientific apparatus, including dynamo machines of various kinds, lamps and fittings, measuring instruments, audiphones and phonographs, besides the regular appliances of a chemical and an electrical laboratory. There are forty pupils in connection with the college, part attending the classes and part engaged either on the indoor or outdoor work of the Hammond Company, the scheme of education embracing one year's course of theoretical study followed by a year of practical training. The building includes class room, laboratories, and workshops, and is fitted with all the requirements for the demonstration of electrical science.

The Electric Lighting Act.—The following compose the general committee, formed on the suggestion of the President of the Board of Trade, to frame clauses in amendment of the Electric Lighting Act, 1882, and to confer with the Board of Trade as to the terms of the provisional orders and licences —The Right Hon. Lord Thurlow, chairman of the Anglo-American Brush Electric Light Corporation, Limited; The Viscount Anson, Sir F. Abel, K.C.B., F.R.C.S., Sir F. J. Bramwell, F.R.S., Sir Charles Bright, M.I.C.E., vice-president of the Society of Telegraph Engineers and Electricians; Sir Daniel Cooper, Bart., K.C.M.G., chairman of the Electrical Power Storage Company, Limited; Sir Rawson W. Rawson, K.C.M.G., C.B., chairman of the Pilsen-Joel and General Electric Light Company, Limited; Sir David Salomons, Bart., Sir Wm. Thomson, F.R.S., LL.D., Sir C. L. Young, Bart., chairman of the Hammond Electric Light and Power Supply Company, Limited; Professor W. E. Ayrton, F.R.S., Mr. J. B. Braithwaite, Jun., managing director Great Western Electric Light and Power Company, Limited; Mr. R. Campbell, Mr. Latimer Clark, M.I.C.E., Mr. Henry Cunynghame, author of "The Law of Electric Lighting"; Mr. J. Irving Courtenay, Mr. R. E. Crompton, of Messrs. R. E. Crompton & Co.; Professor W. Crookes, F.R.S., Professor Ewing, Professor G. Forbes, M.A., F.R.S.E., Mr. James Staats Forbes, chairman Edison and Swan United Electric Light Company; Captain Douglas Galton, C.B., F.R.S., Mr. Herbert C. Gibbs, Mr. J. Dixon Gibbs, director the National Company for the Distribution of Electricity by Secondary Generators, Limited; Mr. R. Hammond, managing director of the Hammond Electric Light and Power Supply Company, Limited; Mr. F. Ince, of Messrs. Ingledew and Ince, solicitors, Professor A. Jamieson, C.E., F.R.S.E., Professor Fleming Jenkin, LL.D, F.R.S., Mr. W. H. Massey, M.S.T.E., Mr. William Ladd, Mr. George Offor, general manager South Eastern and Provincial Brush Electric Light and Power Companies, Limited; Major S. Flood Page, secretary Edison and Swan United Electric Light Company; Mr. A. Renshaw, of Messrs. Renshaw, solicitors, Mr. J. S. Sellon, vice-chairman Anglo-American Brush Electric Light Corporation, Limited; Colonel F. G. Steuart, Mr. J. Swan, Professor Silvanus P. Thompson, B.A., D.Sc., M.S.T.E., Mr. Hugh Watt, managing director Maxim-Weston Electric Company, Limited; Mr. E. Woods, vice-president of the Institution of Civil Engineers; Mr. Frank Wynne, general manager Anglo-American Brush Electric Light Corporation, Limited.

The first meeting of the committee was held on Wednesday, at the offices of the Anglo-American Brush Electric Light Corporation. Among those present were Sir Charles Bright, Sir David Salomons, Professors Silvanus Thompson, George Forbes, and W. E. Ayrton, Colonel Steuart, Major Flood-Page, Captain Douglas Galton, C.B.; Messrs. J. S. Sellon, R. Hammond, J. W. Swan, R. Campbell, H. Cunynghame, J. I. Courtenay, A. H. Renshaw, F. Ince, and Frank Wynne. Letters of apology for absence were read from Lord Thurlow, Sir Frederick Bramwell, Professors Jamieson, Fleeming Jenkin, and others. Mr. J. S. Sellon was voted to the chair, and Mr. Emile

Garcke was unanimously elected honorary secretary to the committee. The following names were added to the general committee :—Shelford Bidwell, E. W. W. Edwards, Clement Higgins, and Musgrave Heaphy. It was then proposed and carried that an executive committee be appointed to prepare draft clauses to be submitted to the Board of Trade, and the following gentlemen were elected by ballot to constitute such executive committee :—Sir Frederick Bramwell, Mr. J. S. Sellon, Mr. R. E. Crompton, Captain Douglas Galton, C.B., Major Flood-Page, Mr. R. Campbell, Mr. R. Hammond, Mr. J. Irving Courtenay, and Mr. J. Staats Forbes, with Lord Thurlow as chairman and Mr. E. Garcke as honorary secretary, to whom any communication may be addressed, at 112, Belvedere Road, Lambeth, S.E.

Parliamentary Powers.—The following applications are to be made to Parliament next Session :—The Corporation of Ramsgate, for power to provide and maintain for its establishments or offices telegraphic or telephonic communication between any parts of the borough. The Corporation of Hastings, for power to provide for the regulation, alteration, and removal of pipes, tubes, wires and other apparatus connected with telegraphic, pneumatic, telephonic, electric, and other purposes within the borough, and to establish communication by any such means between the Town Hall and the several offices of the Corporation. The Corporation of Wigan, for power to prohibit or regulate by license or otherwise "the placing or maintaining of wires, conductors, cables, tubes, or other projections, works, or things, over, above, along, across, or beneath streets or other public places within the borough." The Corporation of Bradford, for power to erect and maintain electric lines and works, and to supply electricity within the borough. The Borough of Mossley, provision "for licensing, regulating, and otherwise in relation to the fixing, placing, or attaching of telegraphic wires, tubes, and apparatus." The Corporation of Lincoln, authority to acquire the undertaking of the Lincoln Gaslight and Coke Company, and power to produce, store, distribute, and supply, for public or private purposes, light, heat, or motive power by means of electricity or any light (other than gas) produced by artificial means or power. The Chelsea Electricity Supply Company, Limited, notify its intention of applying to the Board of Trade, under the provision of the Electric Lighting Act, 1882, for a Provisional Order empowering it to produce, store, and supply electricity within the parish of Chelsea.

United Telephone Company v. Henry & Co.—In this action, on Wednesday last, for an injunction to restrain the defendants from infringing the plaintiff company's patents, the plaintiffs' case was that an agent of the company saw some transmitters and receivers in the defendants' shop window, and purchased a transmitter, and on the following day a receiver. The defendants' case was that the articles had been obtained by fraud. The Vice-Chancellor, Sir James Bacon, was of opinion that the evidence proved there had been no sale, and he therefore dismissed the action with costs.

The New Orleans Exhibition.—Ex-President Arthur, remaining in Washington, set the machinery in the New Orleans Exhibition in motion on Tuesday last, by means of a telegraph wire from the Executive Mansion.

Underground Wires in America.—In his annual report upon the streets of Washington, Capt. F. V. Greene pays much attention to the successful operation of underground electric wires in the city. "Substantial progress was made during the year," he says, "6·11 miles of line and 285 miles of wire being laid underground." The report says: "the standard cables have been in constant use, without a fault, for telephone, telegraph and fire alarm purposes for nearly a year." It continues: "The Western Union Company, which has one-half of all the mileage of overhead wire within the city limits, is alone in refusing, or at least in neglecting, to take any steps toward burying its wires, although urged to do so by the Commissioners. All applications for new poles for the telegraph companies, or for removing their pole lines, have been uniformly refused. Their wires are now much interfered with by the growing trees, and in order to get their wires out of the foliage they have resorted to the expedient of splicing the tops of their poles. But the trees will soon overtake them, and this, and the rotting of their poles, will in a few years compel a settlement of the matter, even if legislation is not obtained requiring the removal of their main pole lines. . . . The close of this year will see about 300 miles of underground wires for telephone, telegraph, and electric light purposes in full and successful operation in this city. It would seem, therefore, that the time had passed for discussing the feasibility of underground wires, and the time had come for compelling the removal of all overhead trunk lines within a reasonable period."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Jensen Electric Bell Company, Limited.—The statutory return of this company, made up to the 28th ult., was filed on the 10th inst. The nominal capital is £25,000 in £1 shares; but the only shares at present issued are the seven taken up by the signatories to the memorandum and articles of association, and upon these no call has yet been made.

CITY NOTES, REPORTS, MEETINGS, &c.

Swan United Electric Light Company, Limited.

AN adjourned general meeting of the shareholders of the above company was held on Tuesday afternoon last, at the Guildhall Tavern, under the presidency of Mr. James Staats Forbes, chairman of the company. There was a good attendance.

The Chairman said: Gentlemen, in conformity with the determination of the proprietors at last meeting of the company, on this day week, we stood adjourned for a week. A notice was sent out to the proprietors reminding them that we should reassemble for the purpose of reconsidering the re-election of directors. I daresay the proprietors present will remember exactly how the matter stands. The wish was expressed on the part of a considerable portion of the proprietors present that they should have the opportunity of suggesting, not the re-election of the retiring directors, but what was called the introduction of new blood. (Hear, hear.) We felt on this side of the table that that was a rational request, and at the end of some discussion it was determined that the thing should be adjourned for a week in order that the leading proprietors might meet, and might come to this meeting prepared to propose either at discretion the re-election of the retiring directors, or propose such names as they would consider would fairly represent the leading proprietors, or a considerable section of the proprietors, and would be useful to the company in strengthening the board from one point of view, and giving greater confidence to the general body of the shareholders. This being the business of the meeting I shall be very glad to hear what the representatives of the leading proprietors have got to say.

Mr. J. W. Swan said: Mr. Chairman and Gentlemen, I do not think my position as a director of the company disqualifies me from suggesting a course of action at this meeting. What I rise to propose is that the meeting should re-elect the three gentlemen who retire by rotation—Major-General J. S. Trevor, Mr. J. C. Stevenson, M.P., and Mr. Ernest Villiers. In recommending this course of action I feel that I may well use an argument which was used at the last meeting by one of the speakers—that it was not well to swap horses when crossing a stream. (Hear, hear.) But, in addition to that argument, I might add this, that I conceive the business of the company—in which I am as deeply interested as any of you, probably more so, for I have not only a pecuniary interest, but a moral interest—has suffered very greatly as to its prosperity from the circumstance, the perfectly inevitable circumstance, that at the outset there were no persons who were acquainted with the business. We had to start the management of the company by means of directors, who, from the necessity

of the case, did not understand the kind of work which was to be done. I believe that the slow progress the company has made has been entirely the result of the inexperience of the directors, an inevitable inexperience, because there were no directors to be had who were acquainted with the business. (Hear, hear.) Well, I think that if we choose other directors than those who have served, as it were, an apprenticeship to this business, we should be sacrificing the very valuable experience which, up to the present time, they have gained, and which, I think, more particularly is going to be exceedingly valuable just now. I do not think, in addition to this, that you could find three men who have all the other qualifications in excess of the qualifications our present directors possess; I mean the qualifications of general competency and assiduous attention to the details of the business. Mr. Stevenson is quite exceptional in having had a longer experience of electric lighting than probably any other commercial man in England. He was the chairman of the first-formed incandescent lighting company in England. For these reasons, gentlemen, I propose the re-election of the three retiring directors.

Mr. Dobree said that he had listened with very great attention to the words which had fallen from Mr. Swan, but at the same time he entirely disagreed with him.

A Shareholder rose to order on the ground that the resolution before the meeting had not been seconded.

Major-General J. S. Trevor rose and seconded the resolution. While he was on his feet he should like to say a few words as regarded their foreign business. He knew that the report presented at the last meeting had not been quite fair to the progress of their work at Lille. It was not in fact an accurate statement. As they were aware, the company had given Mr. Swan £110,000 for his foreign patents. If they turned to the accounts they would see that during the two years and four months they had been in existence, that sum had only been increased by about £3,000. When they took over their foreign business, the manufacture of lamps on a satisfactory scale was possible and the quality was good. But unfortunately the sales had not been large. They had had very severe competition to meet. Other companies had carried out installations and exhibitions at their own cost, and the result to them had been somewhat disastrous. They did not enter into competition with that unprofitable kind of business. They contented themselves with bringing their manufactures before the public. They had also entered into legal proceedings in order to defend their own interests, and since they had taken the initiative, he was glad to say that the number of their customers had much increased. He considered that their business had prospered very fairly indeed. The number of sales this last quarter had been more than double that of the previous quarter so far as he could make out. But for the unfortunate destruction of their factory at Lille by fire, the earning would have equalled about seven per cent. on their £130,000 of foreign capital. He made out that result in this manner. They paid £650 at Lille for salaries and wages of workmen, and in return for that not a single lamp had been manufactured. Besides, they had bought from the Newcastle factory a large quantity of lamps, and the difference between their price and what they could have made them at amounted to another £1,250. Further than that, they got orders for a large quantity of lamps which they could not obtain either from Newcastle or their own factory, and the profit on that would have amounted to about £900, the total being thus raised to £2,800; and if they took this sum of money, £400, which in the accounts was shown as loss, £2,400 would have stood to their credit on the quarter's business but for that unfortunate fire, and that sum came to about seven per cent. on the capital. As regarded the future prospects of the business, his impression was that an expansion was almost certain, and that they could look for a very fair return indeed on their foreign investments. As regards their English business, he believed there had not been a single piece of business into which they had entered upon which they had not made more or less profit. The only thing on which they had lost money and in which they had, he thought, made a great mistake, was in connection with taking out provisional orders. They thought the *raison d'etre* of their company was to carry out lighting by rental all over the country, just as in the same way as gas companies supplied gas. When London was parcelled out into divisions, they had taken four of the best, and they had had a struggle to get them which cost them money; but by the time they had got the orders and begun to realise their position a great fall in electric shares had taken place, and he did not think the shareholders would feel justified in embarking in further enterprise; and therefore they had refrained from proceeding. All that they had obtained in connection with these orders was the contract with the London, Chatham and Dover Railway Company to light their station at Victoria. They had made that the centre for their Victoria district, and the establishment of that centre was not with the sole object of carrying out the lighting of that station, but to enable them to work successfully for the whole district. The building was now large enough to light the whole district, and they had machinery enough to supply the whole station and the buildings round about at the present moment. He thought if they got all those station premises they would have a very successful result. He was going to leave their board. He left it with the firm conviction that the worst days of the company were over; that though there were troubles still to be encountered, yet the worst was really over, and that they had before them a brilliant future.

Mr. Dobree said that now that he was in order he had to say that he did not propose the resolution he now intended to submit as a personal matter. He had no personal feelings against the gentlemen whom he meant to propose that they should not re-elect. He had no doubt they had honestly done their best to manage successfully the affairs of that company; but he also represented a large number of shareholders. He was not satisfied at present that their efforts had been crowned with success. It was not the opinion of the public, and it was not the opinion of the large shareholders, and they were determined to bring some fresh blood on the board. (Hear, hear.) At the last meeting in this room the party he represented were either present, or present by proxy, to the extent of nearly £40,000. That was a very large proportion of the £3 paid shares, and he thought they were entitled to have some say. He hoped those gentlemen whom it was now proposed to dispossess would accept his apology in all frankness. He begged to propose, as an amendment to the proposal of Mr. Swan, that the directors now retiring in rotation be not re-elected, and that Mr. W. C. Quilter and Mr. Frederick R. Leyland be elected directors. He had no doubt that the names now proposed were known to most men in that room. Mr. Leyland was well known as one of the largest shipowners in Liverpool, and known to be a man of great business capacity. Mr. Quilter was one of the originators, they might say, of this company. He and his friends had backed the company up to an enormous extent, and he thought that it was expedient that men who held a great stake in the company should have some voice in the active management of the company. He did not propose that the third place on the directorate should be filled up at present. He thought it would be well to let all the shareholders consider the matter a little longer, and he thought, too, it would be well to leave the filling up of the third vacancy to the board, it being understood, however, that any person filling the third vacancy should be summoned from outside, and not be one of the board itself. He begged to propose this resolution. (Hear, hear.)

Mr. Verity and Mr. Balfour both rose to second the motion. The former was called upon by the chairman to speak. He had, he said, come to the conclusion that the best thing for all parties was that these three gentlemen should be allowed to retire. He felt himself that they owed a debt of gratitude to the two gentlemen who had been nominated to fill the vacancies. He could speak for Mr. Quilter, who was engaged in business of the most active kind. He was sure they would feel more deeply indebted to him a twelvemonth hence than they could possibly feel now. The interests of the shareholders are the interests of those whom it was proposed to elect; every time either of them attended a meeting of the board it would be a personal sacrifice in the shareholders' interests. He thought that the election of these gentlemen would help the shareholders to have full confidence in their directors.

Mr. Villiers, one of the retiring directors, said he did not feel anything but gratitude to the shareholders of this company. He had great pleasure in retiring in favour of two such as had been proposed

Mr. Stevenson remarked that the proposed changes in the directorate lay entirely in the shareholders' hands, and he had no complaint to make at a time when the company had seen its worst and saw its way to greater success in spite of all difficulties encountered. None of the directors had the slightest ambition to continue in their places longer than the shareholders wished, and the shareholders present had an overwhelming preponderance of voting power in favour of the proposed changes. He was glad to find that the new board would go on to do what the old board had striven to do without success, that was, to distribute the shares among the shareholders. (Hear, hear.) He hoped also that the change would have no injurious effect on the litigations for the defence of their patents which were proceeding in several countries in Europe. Since the directors had taken courage to face their opponents they had had a larger business than before. He had to congratulate the new board that in their manager, Mr. Stearn, they had a man in the highest degree qualified to undertake the work which he had in hand. (Hear, hear.) He did not think the board would suffer from the addition made to it of two such business men of active experience; indeed, their services could not but be of great service to the company. (Hear, hear.) He begged to thank them for their past confidence, and he was glad to think that he was leaving the directorate at a time when the prospects were so very much more favourable. (Hear, hear.)

Mr. Kempster said he was sorry that he was unable to support the very happy family arrangement which seemed to have been made. Whilst those who made that arrangement did not seem to be actuated by any other than honourable motives as to their treatment of the two gentlemen who were to be elected, he did think that he had not for a long time heard of a more unhandsome, more ungrateful, and more inexpedient act of company-mongering than that by which they were going to kick out from the board the three gentlemen who had done more active service there than any others. (A voice: "Hear, hear.") It was the act of what he would venture to call a ring of the proprietors who knew they had the votes of the meeting and who said: "Now is our opportunity." That policy, with its most unusual and inequitable arrangement, might answer for a time, but it would not do for very long, and he was sorry that gentlemen of such repute as Mr. Leyland and Mr. Quilter—against whom he had not a word to say—should have lent themselves to such an arrangement. They had displaced one very honest, and one very industrious, and one very conscientious director; and they were going to kick them out for their honesty and their devotion to the service of the company. If they must have new blood, why not elect these two gentlemen who had been proposed as well? (A voice: "Hear, hear.") The policy proposed was merely one of

that continuous series of blunders that had been the guiding principle of that company all along; but of all the blunders made, and there had been blunder after blunder, this, as a matter of policy, was the greatest. He thought they would find when the large and small proprietors throughout the country got to the back of the transactions that led up to this arrangement, there would come a severe retribution, and there would be an addition to the reputation which certain gentlemen had gained with regard not only to company-mongering transactions, but with regard also to the high-handed policy of clutching at power and of getting it for their own advantage and for their own ends. (Hear, hear, and hisses.)

Mr. Foster would not, he confessed, have been present at that meeting had he not observed in the report of last meeting of the company that a gentleman had taken part in the proceedings who he knew had been the cause of dissension in at least one other company with which he had been connected. He (the speaker) had, he might say, only a nominal interest in the Swan Company, so that he had not come to defend his own pocket. He believed that no arrangement would be likely to meet with Mr. Kempster's approval that excluded him from taking a leading part in the company's concerns. He (Mr. Foster) had referred to a company that his firm had had a hand in bringing out and promoting.

Mr. Kempster: Hear, hear! Promoting!

Mr. Foster believed that a company could be promoted honestly, and he did not fear to say that his firm *did* promote that company, and he challenged any enquiry made in reference to that promoting. (Hear, hear.) At a large meeting of the shareholders of that company Mr. Kempster, who held three shares in it of £1 each, which he had received as part payment of an advertisement which he had inserted in a newspaper (Laughter), delivered a speech which was almost word for word the same as that which he had delivered at the last meeting of the Swan Company. Mr. Kempster was much like a bull in a china shop, and they had to conciliate him. (Laughter and interruption.)

A Shareholder asked if it was proper that the speaker should air his own grievances and introduce so much personality into the discussion?

Mr. Foster, continuing, said that he had no desire to air any personal grievance, because he had none.

The Chairman said that it was surely not desirable to prolong such a discussion. But still the remarks of the previous speaker to the last, who he thought only held five shares in the company, reminded him of the saying: "When Bishop Berkeley said there was no matter, it was no matter what Bishop Berkeley said." When they found a man telling them that other people were very dishonest, and that he was the only honest man, all the advice he could give them was: "Lock up your pockets." (Laughter.) The offence apparently was that the proprietors of that concern, who had a substantial stake in it, thought fit to govern themselves. Well, thank God, in companies, at all events, they had not yet come to manhood suffrage. But declaiming, want of knowledge, and great hardihood of statement carried away a lot of unthinking people. The proprietors, as men of intelligence and position, could judge the real value of the balderdash which Mr. Kempster had talked, and he did not propose to take any further notice of it. As to the proposed introduction of new blood, he must say that his colleagues and himself had not seen the necessity for it. But they accepted seats on the board on the usual conditions: if they succeeded all right; if not, they must be kicked out. In face of the strong expression of opinion, however, that the company did want other men on the board, he was not going to say a word against the amendment, and it was his duty to move it, with a slight modification, necessitated by their articles of association. The proposed amendment ought to stand thus: "That the number of directors be reduced from eight to seven, and that Mr. W. Cuthbert Quilter and Mr. Frederick R. Leyland be, and hereby are, elected directors of the company." Otherwise the directors would have had the invidious duty of deciding which of their number should be asked to retire. He therefore suggested that the mover of the amendment should accept his alteration of the form of his motion, and should move it in its new phraseology.

Mr. Dobree thereupon formally moved the amendment as suggested, and the chairman having put it to the meeting, declared that the "Ayes" in its favour had it. There would therefore be no necessity to put the original motion of Mr. Swan.

Mr. Quilter, in returning thanks for his election, said that he had consented to take office with very considerable reluctance, as, independently of his time being very valuable, it was an extremely disagreeable thing for a director to be exposed to such remarks and insinuations as they had that day heard.

Mr. Leyland also thanked the meeting for its confidence. The post to which he had been elected was not of his own seeking. But he represented nearly a third of the share capital, and with such an interest, he felt that he could not decline the office when his friends asked him to accept it. (Hear, hear.)

The customary vote of thanks to the chairman closed the proceedings, Mr. Kempster having in vain tried to obtain a hearing.

The Consolidated Telephone Construction and Maintenance Company, Limited.

THE third ordinary general meeting of the shareholders of this company, adjourned from May 23rd and July 25th, was resumed at the Cannon Street Hotel, on Tuesday, under the presidency of Mr. C. L. W. Fitzgerald. A further report of the committee of investigation was submitted, and was fully dealt with by the Chairman.

Mr. Charles Curtoys, the secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen—Time is money, so I don't mean to detain you long. I must make a few remarks first of all on the allotment. It appears to the committee that that allotment was a very discreditable transaction on the part of the late board; and there is one thing that strikes me as very remarkable, and that is why there should have been what I may term a double allotment—one on April 22nd and the second on the 26th of the same month. Of course there is a reason for that, but I do not know what that reason is. However, you will find in the report that Sir Julius Vogel sent in a written application for 1,000 shares, and that he was allotted 3,330 shares; that in the allotment register the 1,000 was altered to 5,000, and there was no further written application made. Now, the counsel's opinion states that Sir Julius Vogel, for any shares over and above the 1,000 he applied for, is liable to the company for the profit that he made on the sale of those shares. (Hear, hear.) That seems very just, I think, if one considers it, and I would suggest that you allow this matter of taking proceedings against Sir Julius Vogel to be left in the board's hands. I think by that means possibly we may find some way of getting back a sum of money for you shareholders from Sir Julius Vogel. I hope we may; at all events we can but try. Now, before I go any further, I should like to say a word on the subject of that circular which the directors sent round, informing the shareholders when they paid the first dividend that they thought they would be in a position to pay regularly quarterly dividends of 10 per cent. per annum. I don't know of any similar action by a board, and it seems to me very irregular. Certainly it was likely to lead shareholders to purchase shares in the market. And then we come to the fact, almost immediately after that circular was sent round, that Sir Julius Vogel was selling his shares. Well, gentlemen, really I hardly know what to say to a proceeding of that sort. Anyhow, that is absolutely what happened, and I think I need not say more on that point than that we will use every endeavour to get something back from Sir Julius Vogel. Of course we do not contend for a moment that the profit was not made. Those first three dividends were earned, there is no doubt about that. The only question to our minds is whether they ought to have been divided up so quickly. It would have been more prudent, it seems to us, to have waited a little while to see how the company got on. The next point is the history of the 4,000 telephones contract. We have made that history rather a long one in the report, so that you may be made fully aware of all the facts of the case. Of course we wish the shareholders to know everything about their company, and all that has taken place in it; therefore we made this as full as we possibly could. But I should just like to tell you, in as few words as I can, what my idea is, and I think I may say the committee holds the same opinion as myself. It is this—that Colonel Gouraud, Mr. Bigelow, and Mr. Cargill had sold the Edison-Gower-Bell patents to the Oriental Telephone Company, and the sum agreed to be paid was £50,000 in cash and £100,000 in fully paid shares. On this transaction coming to Mr. Gower's knowledge he said, "I have certain rights in the Oriental districts, and if you don't pay me, or in some way compensate me, I shall fight you." That naturally alarmed the directors who were bringing out a new company, for the prospect of a fight at the start would naturally frighten the shareholders from taking shares. As a means of stopping Mr. Gower's mouth, Messrs. Gouraud, Bigelow, and Cargill entered into a contract to take from Mr. Gower 4,000 telephones. This satisfied Mr. Gower probably. The Edison Company smoothed over the difficulty, and eventually only £40,000 in cash and £75,000 in fully paid-up shares was paid for the joint patents. Well, time went on, and your company purchased Mr. Gower's business, and amongst the business was this contract for the 4,000 telephones. No doubt you paid a large sum of money for that. I tried to get out of Mr. Gower what the amount was, but he evaded that point. I wrote to him, but he would not say how much exactly he estimated that contract at. You see in Sir Julius Vogel's memorandum, however, that Mr. Gower estimated it as worth £20,000 at least. Well, gentlemen, now you see, also according to Sir Julius Vogel, that Colonel Gouraud from the first apparently tried to get the contract set aside. After various attempts by your board to get the contract completed, a company called the Telephone Supply Company comes on the scene. Now is it possible that the directors enquired into who that company was? Because if you turn to the report you find that it consisted of Mr. Cargill, 198 shares; Mr. Cheston, 1; Mr. Cheston, 1; Mr. Hubbard, 299; Mr. McLeod, 1; Mr. Bigelow, 100; Mr. Edison, 200; Mr. Gouraud, 197; Mr. Grigg, 1; Mr. Kingsbury, 1; and Mr. Allen, 1 share. It seems to me very much like handing on the contract from the three purchasers of the contract to almost the same people, who form what has been familiarly written about as "the telephone ring." The *World* and *Truth* have written about them a good deal. It seems to me if they (the directors) had enquired into the matter they would not have handed over that liability to the company. However, that company came into existence, and they made one payment of £1,800, and then the board allowed Mr. Gower to assign the Oriental patents, by which they practically lost the security which they held for the the contract. I understand that they were advised that they were obliged to do so; but I can hardly believe it myself. Difficulties arose, and the report says that Messrs. Gouraud, Bigelow, and Cargill, could not use the 4,000 telephones in the

United Kingdom. In the agreement it is expressly stated that they could use them, but for all that there was some reason in the background why these telephones should not be used in the United Kingdom, and, strange to say, I have only come across the reason within the last week. It was this: I have seen in the possession of Messrs. Waterhouse and Winterbottom a printed document bearing date of 8th April, 1881, and it is printed "Heads of agreement." The names of our solicitors, Messrs. Mackrell, Maton & Co., and of the United Company's solicitors, Messrs. Ashurst, Morris & Crisp, are upon it. Attached to that is a schedule, and in that is the 4,000 telephones contract put down as "Oriental Telephone Company." Now, our schedule, which Mr. Gower signed, has these 4,000 telephones entered as "Messrs. Gouraud, Bigelow, and Cargill, London," but there is a query against them. What it means I don't know. With the assistance of Mr. Morgan, of the United Company, I am going a little further on in this 4,000 telephone case. I hoped from the first we should get something out of it; but you see in the report on the evidence we have at present, there is no case against your directors or any of the parties concerned, but I don't mean to let it drop. Now we come to a more agreeable subject—what we have been doing here, in London, and abroad in various countries. The first thing that the present board did on coming into power, was to endeavour to the very utmost of their ability to establish friendly relations with the United Telephone Company, and its subsidiaries, the National, the Northern, the Lancashire and Cheshire, and the Telephone Company of Ireland, and I am happy to state, without any fear of contradiction whatever, that we have the most cordial relations with all those companies at the present moment (hear, hear). You will recollect that at our last meeting, on July 25th, I told you that we thought we could make the manufacturing business pay a little. Since then we are further strengthened in our views on that point, because we find that there is a very large business doing in the manufacture not only of patented articles such as the receivers and transmitters, but also of articles in connection with the telephone exchanges; and that business, I should say, has principally gone into other hands, the Silvertown Company, Blakey-Emmott, and one or two others, and we are striving to the very utmost of our power to wrest that business away from those companies, and get it back into our hands. If we cannot do it it will go very hard with us. I think we can. We have machinery in those works of yours which cannot be equalled in Europe: it may possibly in Antwerp, but I think not. As soon as we get our legs we mean also to go on the continent and compete for business there. There is no reason why we should restrict our business to England; there is plenty of work on the continent. The only thing I can see to prevent our making a profit is litigation on various points. That is really the one point we have to fear. I have just roughly jotted down a few figures of what money we received and what we paid out, and how we stand at present, just to show you that the company at all events is in what you may call smooth water. According to the report of May last—the annual report—on coming into power we found we had to pay £3,500, and there was £100 at the bank to do it with. There was certainly a sum of £3,150 due from various people, but on looking carefully through that, we found that it consisted a great deal of consignments of goods abroad, which were not sold. We had altogether about £200 to lay our hands upon. The board proposed, to get rid of these liabilities and to have further working capital, that some of you should purchase River Plate debentures and shares from us. I am happy to state that the River Plate shareholders then came forward in a manner I did not expect, and took something like £2,000 worth of shares. In all, we received from the sale of debentures and shares about £9,000; and from that company we further received debenture interest £1,200, £500 in cash, and we discounted two Edison Gower-Bell bills, about £600 altogether; and we received, after a very hard fight for it, the money from Australia, £800; amounting, in all, to about £12,000. All the debts have been paid except the solicitor's bill, which we could not settle; we were in hopes of a compromise, but could not bring it about. Those debts amounted to £2,700; we provided the money for Austria, £4,500; a further sum of money for the Edison-Gower-Bell, £1,300; the income-tax was reduced £100 to £240; and we spent about £100 on the machinery, in repairs, and one thing and another; this amounting altogether to £8,840, which leaves a balance of £3,360. We have in the bank at this moment £4,333, and we have perfectly good debts, owing to us for instruments which we have sent out, £5,200; making, in all, £9,500; so that you may safely say your company is perfectly solvent now, at all events. With regard to the River Plate Company, someone, I could not tell you who, sent a newspaper round to all the shareholders of the Consolidated Company, containing a statement of the fact that they had an opposition company in the River Plate. I do not know with what object that was sent round, whether to frighten the shareholders or not; but I thought, naturally, that they were all aware that there was an opposition company in the River Plate. I am not aware that the late board kept that in the dark. Anyhow, there is the opposition. Mr. John Taylor, who is the present chairman of the River Plate board, and also a director of this company, has gone out to the River Plate, and with him sailed the chairman of the opposition company; and those two gentlemen have gone out there in the hope that we shall arrive at some satisfactory compromise, and the probability is that those two companies will be amalgamated; that will be the most satisfactory thing for you. That business is a very good business; the only doubt we could possibly have was that we should fight and cut each other's throats. I believe, if we can interpret the telegram we have received, that the managing director of the other company is on his way to England with a proposal for amalgamation. The Edison-Gower-Bell Company we have not at present got into our own hands, but your board has made a proposal to the Edison-Gower-Bell board, and I hope and trust that these proposals will be accepted; if they are, I think you will find them very satisfactory for the Consolidated Company. We are doing very well in Austria. The last report, which I received yesterday from our manager, stated that he had 810 telephones running; and in July last, if you recollect, we only had 605. I think that is a very satisfactory increase; and we have plenty more people to work upon. I should further tell you that, seeing we have such a very large stake out in Austria, your board has deemed it advisable to send one of the directors out to personally inspect whether we really have the property or not. We believe we have, but he is gone out to make sure; he sailed last week. I have no doubt, in my own mind, that he will come back with a satisfactory report. The next thing of importance we did in your interest was this: our present manager had to go to New York on his own private business, and we thought that a good opportunity to open up negociations with the American Bell Telephone Company, so that we might have friendly relations with them as well as with the United Company. That is all I have to say now; but if any gentleman has any questions to ask I shall be happy to answer them.

A Shareholder asked what the litigation was of which the chairman spoke.

The Chairman: That is only if gentlemen should attack us. We have no litigation at present. The only law suit we have is in Australia, respecting which the latest advices are most satisfactory. Our opponents out there are likely to come to a compromise with us and pay the costs which they have made us incur.

The Shareholder: You seemed to think it likely that there would be litigation.

The Chairman: Any one who knows anything about it will tell you that in the telephone world there is always the possibility of it.

Another Shareholder enquired if there was any probability of an action with the United Telephone Company.

The Chairman: I can assure you we shall have no litigation with the United Company. The Chairman then moved the first of the resolutions of which notice had been given, that the original and further reports of the committee of shareholders appointed on the 23rd May, 1884, be adopted.

Mr. Buckingham seconded the resolution, and said he felt that they were very much indebted to the committee for what they had done; he hoped they would go on investigating as far as they possibly could, and when they felt they had the right piece of game in their hands they would then do what was necessary, but on no account must they spend what little money they had in any uncertain possibilities of the law. He saw that the directors had done him the honour of putting him on the board of the Edison-Gower-Bell Company; he understood that that company was not in existence yet, but when it was, if he could in any way serve the interests of the company he should be only too pleased to do it; at the same time he had no desire to have a seat. He had done all he could, although not a member of the committee, to assist the chairman in his investigations, and he still felt it his duty to do so. The chairman had spoken of a certain sum of money in the possession of the company, but he did not agree with the chairman on that point. It was sufficient that they had the money, however; the difference was only a matter of details, and he would suggest to the directors that they should not think of giving that money away at present in dividends, but utilise it to strengthen the resources of the company. He believed that there was a future for the company, and his advice to the directors was to husband their resources until they had threshed out every doubtful point, and then, in the course of a few months, he hoped they would be able to come before the shareholders with a small dividend. In conclusion, he would say that whatever money they might get, he should like to see them build up some kind of reserve fund.

The Chairman said, with respect to the question upon which Mr. Buckingham held a different opinion to himself, it was only as to the manner of making up the amount. Six shareholders had carefully considered the question, and had come to the conclusion that they might fairly value the assets at the amount stated, about £170,000. He as chairman, with the prospect of paying a dividend, would like to knock the capital down to a quarter of the value set upon it, for that would enable him to pay a much larger dividend; but they had to deal with things as they found them, and the shareholders might depend upon this, that having got the money, they meant sticking to it and not spending it rashly.

The resolution was then put, and carried unanimously.

The Chairman proposed the next resolution, authorising the payment out of the funds of the company of the legal and other expenses incurred by the committee. These expenses amounted to about £50, and there was no liability outstanding.

Mr. Green seconded, and the resolution was carried.

The Chairman moved the adoption of the annual report and accounts, dated 14th May, 1884, subject to such readjustment as might be necessary in respect of the loss sustained by the company by the compromise of the action brought in respect of the 4,000 telephones contract. This, he said, was a report which did not please him very much when he first saw it, but he thought it desirable to pass it now. The board thought that £7,050 of the credit balance of £10,290 in the revenue account should not be

taken as profit at all, for the very good reason that it related to the 4,000 telephones contracts, upon which a much larger sum must have been paid. He was very well aware that no specified sum was put down at the commencement of the business for the 4,000 telephones contract, but he could not see that this was a profit. They had taken it as a sum which would in future be written off against good will and patent rights, &c. A further sum, amounting to about £3,200, they thought might be used to write off the items of plant, bad debts, &c., as it seemed that no reserves had been made for depreciation of plant, machinery, good will and patents.

Sir Alexander Armstrong seconded the motion, which was also carried without dissent.

Mr. Buckingham said he hoped it was in the minds of every shareholder to thank the committee for what they had done. He knew that those gentlemen had devoted an immense amount of time to the affairs of the company, and he hoped he was not undertaking an invidious task in proposing that the shareholders should grant them a small honorarium. One or two of them, he knew, had been at the manufactory day after day for weeks together; and he would suggest that a sum of 200 guineas be voted to them, to be divided in a manner they themselves might think fit. He hoped in making the division that they would take care to recognise the claims of those gentlemen who had done the largest amount of work.

Mr. Pitt-Cobbett seconded the proposal, at the same time expressing regret that in making the changes in the directorate the board had not consulted with the shareholders, and drawn upon existing shareholders for the new board; but he was reassured by the fact that Mr. Buckingham had agreed to join the board at some time or other.

The Chairman said virtue was its own reward, and the committee were satisfied with having been successful. But they were all gratified at the same time by the substantial reward which had been voted them, and thanked the shareholders heartily.

The next subject was the appointment of a second auditor to act with Mr. Griffiths. After some discussion, Mr. Arthur Green was appointed a shareholders' auditor at a remuneration of 25 guineas per annum.

An extraordinary general meeting was then held, and the Chairman moved the following resolution:—"That the capital of the company, which is now £300,000 divided into 300,000 shares of £1 each, of which 224,850 are in issue and are fully paid, be reduced to £243,787 10s., divided into 224,850 shares of 15s. each, and 75,150 shares of £1 each, at present unissued, and that such reduction be effected by writing off from each of the said 224,850 shares the sum of 5s. per share as capital lost or unrepresented by available assets."

Mr. H. Grèwing, a director, seconded, and the resolution was carried.

The following resolutions were then submitted and agreed to:—

"That the following alterations be made in the articles of association, that is to say, article 51, for the words "the nominal amount of the capital" substitute "£50,000."

"That article 87 be altered so as to read as follows:—'Article 87. As remuneration for their services, the directors shall be paid out of the company's funds the sum of £1,500 per annum, and such remuneration shall be divided among them in such shares and proportions as they or the majority of them shall determine.'"

"That to article 89 be added the following clause:—'If he hold or accept any other place of profit or office under the company, with the exception of managing director.'"

"That article 90 be struck out and the following article substituted therefor:—'Article 90. No director shall contract or be personally interested in any contract with the company, but no contract or arrangement entered into by or on behalf of the company with any company or corporation of which any director shall be a member or officer shall be avoided, nor shall any director being such member or officer be liable to account to the company for any profit realised by any such contract or arrangement by reason only of such director holding that office, or of the fiduciary relation thereby established, and such director may vote in respect of any such contract or arrangement.'"

Article 112, nullified by the above resolutions, was agreed to be struck out.

Some discussion followed as to when the directors' fees should commence, and eventually the Chairman stated that the board would agree to take them from July 1st, this meeting with the approval of the shareholders.

A vote of thanks to the Chairman was then cordially carried, and the proceedings terminated.

Lancashire and Cheshire Telephonic Exchange Company, Limited.

(Reprinted from the *Manchester Examiner* of December 9th, 1884.)

A MEETING of the shareholders of this company was held yesterday, at the Memorial Hall, Albert Square, in this city; Mr. Charles Moseley, chairman of the company, presiding.

The Chairman said the meeting was called for the purpose of giving information to the shareholders and the public of the nature of the new agreement with the Post Office, which had been concluded after a large amount of arduous labour on the part of the Board of Directors. The old agreement was granted by the Post Office in the early stages of the telephone, when none of them quite grasped the important field it would occupy in the future, and it was only by experience that they had been enabled to bring before the Government the points in that agreement that were unjust, and so restrictive as to impede the development of the telephone to a very serious extent. They were, in the first place, restricted to a certain radius. In Manchester and Liverpool this radius was four miles, and beyond that point they were not able to go without a special application to the Post Office for a special licence for what was called an ultra-radial wire. In connection with this they were put to trouble, and, instead of the usual 10 per cent., had to pay a royalty of 12½ per cent outside the radius. Then they were not in a position to communicate between two towns, and the anomaly of the position showed itself in this way, that in certain places the radii of two towns intersected each other, but the restrictions of the Post Office did not allow them to communicate directly between these intersecting districts, but they had to ask for a trunk wire. The tendency of the whole arrangement was simply to strangle the telephone as much as possible. They had felt that the injustice they had suffered would be removed as soon as the case was thoroughly understood, and the Postmaster-General felt that the commercial interests of the country required the telephone on their own terms or such as the country was prepared to offer. They felt also that Mr. Fawcett would look upon the subject in the broad light in which he had looked upon most questions, and they therefore sought the assistance of their city and county members and other Members of Parliament to lay the question before the House of Commons, and after very hard work they had brought the matter to a satisfactory conclusion. They would be enabled on very reasonable terms to do exactly as they pleased, which was the position for every man of business and every company to occupy. (Hear, hear.) The new agreement consisted in a 10 per cent. royalty of their gross receipts on the exchange business. There was, of course, no claim on the private wires. The only simple restriction they had was that they were not to compete with the telegraph service in the transfer of written messages. It was intended shortly to open call offices in Manchester, Liverpool, and other towns, and to put call offices on each station platform as soon as they could complete arrangements with the railway companies; and it was calculated they would be exceedingly useful. (Hear, hear.) The present suggested charge was 3d. per message for subscribers and public equally. On the 1st January they would be prepared to open communication between the following towns:—Manchester, Bolton, Warrington, Rochdale, Heywood, Bury, Oldham, Stockport, Liverpool, St. Helen's, Widnes, Runcorn, Preston, Blackburn, Darwen, Accrington, Chorley, Burnley, and Wigan. In order to meet the requirements of all parties they would adopt two systems of charging—one a yearly rental, the other a toll of 6d. per message on credit for monthly account. The amount rate would be based upon 10s. per mile, with a minimum rental of £5 per annum, and the toll rate of 6d. would be for a conversation of three minutes. In the case of subscribers who wished to speak through the trunk wires, at message rates, it was proposed to open monthly accounts. Any gentleman who wished to be a user of the trunk wires would signify the same to the secretary, who would forward him an agreement to sign by which he undertook to accept the records of the company's switch-room as to the number of times that he had used the trunk wires; and he also undertook to pay the account at the end of the month. But in the case of the use of a trunk wire through a call office, the terms would be cash for each conversation. In addition to the towns in their own district, they had arranged with the National Company that their lines should meet on the borders of their district, and the whole of Yorkshire would be put into communication with the Manchester district. (Hear, hear.) It was proposed to follow out the broad principles laid so fully before Mr. Fawcett, to give the public what they wanted, and to give every possible scope for the development of the telephone, and, where practicable, to bring the rates within the uses of all classes. The residential portions of Manchester were an important item, and, in order to bring in domestic subscribers, they had resolved to establish a domestic rate of £12. They had also established a medical rate of £15, because it was thought it would be a great service to the public if all medical men were on the exchange. Under this new agreement they had under consideration arrangements to put their offices in communication with the telegraph stations, and they would be able to deliver or receive telegrams per telephone. They were of opinion that this would be of great service not only to their subscribers, but in the general development of the telephone itself, because a telegram was sometimes greatly delayed which might be well sent forward by telephone. As an instance of the saving of time which would be effected by this arrangement, it might be mentioned that a telegram had been despatched by telephone from the company's office in Manchester, thence by telegraph to London and delivered by telephone, and an answer received by the same means in something under ten minutes. The facility would be so great when this new service was in working order, that probably nearly all the subscribers would avail themselves of it. This was not looked to by the directors as a source of revenue, but as being of great advantage to the subscribers, and as bringing before the public more prominently the usefulness of the telephone. The Chairman expressed the thanks of the company, to the press, and the commercial community, in all Lancashire for their assistance in getting these concessions from the Government, as well as to the city and county embers of

Parliament. It was largely due to the personal endeavours of Mr. Jacob Bright, M.P., and Mr. Dwyer Grey, M.P., that they occupied their present position. Since June last their gross income as a company had increased nearly £4,000, and they had more orders on their books at the present time than they could possibly execute for some time to come. A number of small exchanges which were not remunerative, simply for the reason that they were not able under the old arrangement to give the accommodation they required of communication between small towns, under the new arrangement should prove quite remunerative. In their district of Lancashire since June last they had fixed more than 1,000 miles of wire. He thought it must be generally admitted that they had made great progress.

Mr. Alderman Thompson moved a vote of thanks to the chairman for his statement, and the motion was seconded by Mr. Longson.

Mr. B. Armitage, M.P., supported the resolution, and said he thought it was well that the conclusion of this matter had not been brought about by hasty means, but that the deliberation had been long, and the arguments well considered; and he felt great satisfaction as a shareholder that such an arrangement had been brought about, (Hear, hear.)

The resolution having been carried, the meeting terminated.

The Anglo-American Brush Electric Light Corporation, Limited.

THE following report has been issued by the directors of this company:—

The directors have convened an extraordinary meeting of the corporation to consider, and, if deemed advisable, to pass a resolution ratifying the provisional agreements entered into with the Great Western Electric Light and Power Company, and the Brush Midland Electric Light and Power Company, providing for the absorption of these companies by the corporation, and to authorise an increase of capital to an amount dependent upon the number of fully paid shares in these companies surrendered to the corporation; such increase, however, not to exceed in the aggregate 6,695 fully paid £5 shares in the capital of the corporation.

These are the only two British companies (with the exception of two local companies possessing sub-licenses for two towns on the South Coast), which hold concessions precluding the corporation from doing general business in the districts assigned to them, arrangements having been made with the other subsidiary companies in England (viz., the Hammond Company, the South Eastern Brush Company, and the Provincial Brush Company), by which the corporation are enabled to supply both incandescence and arc apparatus in their districts.

As the shareholders were informed in the last annual report the corporation have found it advisable to take up the position of contractors, and not confine their operations as formerly, merely to the manufacture of electrical apparatus; and this being the case it is desirable that practically the only limitations to the power of the corporation to undertake work in any part of the United Kingdom should be removed by the absorption of the Great Western and Midland Companies.

It is proposed to take over the business of these companies as going concerns, thus securing to the corporation their present local organisations, which it is believed are capable of further considerable development.

The terms of purchase are, in the case of the Great Western Company, that the corporation shall issue shares in the proportion of three £5 fully paid shares for every 20 £2 10s. shares, the shareholders in the Great Western Company receiving in addition out of the available funds of that company 10s. per share in cash. In the case of the Midland Company the terms are, that the corporation shall issue shares in the proportion of four fully paid £5 shares for every 27 £2 10s. shares.

The negotiations which have resulted in the above-mentioned provisional agreements have been most carefully and considerately carried out, and the directors feel that they are justified in recommending these terms to the shareholders as fair and equitable, and at the same time as not without material advantage to the corporation as enabling them more effectually to carry out a policy in the future which past experience shows to be desirable. The arrangements if adopted will involve a maximum increase in the share capital of £33,475, of which £19,362 will be distributed to the shareholders in the Great Western Company and £14,113 to the shareholders in the Midland Company.

For this increase of capital the corporation will obtain not only a return of the licenses for 28 counties in England and Wales granted to these companies, but also the benefit of the operations of these companies during the past two years, from which well organised and established business may be expected to result. The corporation will further receive good tangible assets, including cash, plant, land, buildings, &c., amounting in the aggregate, after deducting all estimated liabilities and expenses, to about £28,500, of which £4,100 consist of calls in arrear. If these calls are all paid the consideration which the corporation will have given for the *licenses and goodwill* may be estimated as not exceeding about £5,000 in shares.

The meeting is called in accordance with the articles of association for the consideration of this special business only, and as the ordinary general meeting will shortly be held, at which the accounts of the corporation, made up to the 31st December, will be submitted, the directors defer their report upon the general business of the corporation and other matters.

The Eastern Telegraph Company, Limited.—This company announces the payment, on the 15th proximo, of a dividend of 3s. per share on the preference shares, less income-tax, for the quarter ending 31st inst., and an interim dividend of 2s. 6d. per share on the ordinary shares for the quarter ended September 30th, with a bonus of 1s. per share, free of income-tax.

Brazilian Submarine Telegraph Company, Limited.—The directors of this company have declared an interim dividend of 3s. per share, or 6 per cent. per annum, free of income-tax, for the quarter ending 30th September, and payable on the 24th December. The books of this company will be closed from the 17th to 23rd December, both days inclusive.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and Electricians.

AN ordinary general meeting of this society was held on Thursday, December 11th, Prof. W. G. ADAMS, President, in the chair. The minutes of the last ordinary general meeting having been read and confirmed and the list of new and proposed new members, transfers, &c., announced, the Secretary (Mr. F. Webb) read the annual report of the council as follows:—

During the past year the muster roll of the society had been increased by the addition of one honorary member, 12 foreign members, seven members, 62 associates and 14 students, or a total of 96. On the other hand, the losses by death had been: 1 honorary member, 9 foreign members, 9 members, and 17 associates. Amongst these losses should be mentioned the names of F. I. Scudamore, R. Sabine (the first treasurer of the society), and the Comte du Moncel. The council had elected Dr. Davy an honorary member of the society in recognition of his early work in endeavouring to bring the electric telegraph forward as a practical invention. The credit of having brought Dr. Davy's labours to notice was due to Mr. J. Fahie, who had presented the documents from which he had obtained his information to the society. The council had to acknowledge the continued courtesy of the Institution of Civil Engineers in granting the use of the theatre of the institution for the society to hold its meeting in. The society's premium of £10 had been awarded to Prof. G. Forbes for his paper on "The Proportion which ought to subsist between the Size of Conductors and the Strengths of Currents"; the £5 premium to Dr. Stone for his paper on "Electric Lighting in relation to Health"; and the Electrical Congress premium to Mr. H. C. Mance for his paper on "A Method of Locating Faults in Submarine Cables"; Honourable mention was also made of Mr. Mordey for his paper on "Some prejudicial actions in Dynamo-Machines." On July the 4th, a conference was held at the Health Exhibition; the annual *conversazione* took place at King's College, by permission of the council of the latter. The secretary then referred to the librarian's report, which would be found printed in the Proceedings of the Society. The thanks of the council were due to the honorary secretaries for their assistance; Mr. J. Dacres, who had retired from the post in Canada in consequence of ill health, had been succeeded by Mr. Angus Grant. The financial position of the society was very satisfactory.

At the conclusion of the reading of the report, the president moved that the same be adopted, which was carried unanimously. The usual votes of thanks were then proposed, seconded, and carried unanimously.

A paper was then read by Mr. W. H. PREECE on "Electricity in America in 1884." In the year 1877 the author visited America officially in conjunction with Mr. Fischer, in order to inspect the telegraphic arrangements in that country. In 1878 he gave to the society the experiences of his visit. His trip to America during the present year was not an official one, but was a consequence of the meeting of the British Association being held at Montreal. The number of members who were present at the meeting was 773, of whom 600 had come from England. The gathering at Montreal was not marked by any great devotion to electrical science. One feature was the discussion of a subject without the preface of a paper, the question considered being the "Seat of Electromotive Force in a Galvanic Cell," the discussion being started by Mr. Oliver J. Lodge. Mr. Preece suggested that Mr. Lodge might with advantage bring the subject before the society in the form of a paper during the ensuing session. He paid a high tribute to the excellent work done and the extreme courtesy shown by Lord Rayleigh and Sir William Thomson. As regards the few electrical papers read, one by Dr. Traill on the Portrush Railway was perhaps the most important. At the termination of the meetings at Montreal, Mr. Preece visited several American towns; a remarkable feature in many of the latter were the universities endowed by private munificence, the Johns Hopkins University, presided over by Prof. Gilman, being one of the most important, the endowment being no less than 3,500,000 dollars; Prof. Thomson in the course of a visit lectured to the students. The American Association, which was holding its meetings during Mr. Preece's visit, was founded on the same lines as the British, in fact, the only difference between the two was in the lettering of the various sections. A good rule was made that the length of the paper should be indicated on the programme; the president had the power to terminate the discussion by any member if it appeared to be the

wish of the meeting that he should do so. The only electrical paper of importance read was one on "Hall's Effect," in the discussion on which Profs. Forbes and Silvanus Thompson spoke with great ability. At the Electrical Congress, which was held under the auspices of the United States Government, Prof. Rowland being president, the unit question was considered, with the result that the Paris Congress Units were unanimously adopted, although the determination by the president of the value of the resistance unit differed from that settled upon at Paris. The author brought forward the suggestion that the unit of horse-power should be 1,000 Watts, and although the idea had been very much ridiculed in some quarters, he believed that it would be ultimately adopted. At the Association the paper by Prof. Rowland on "The Theory of Dynamos" had been well reported in the scientific journals. The result of the discussion showed that very great disagreements existed on the subject. It was a somewhat remarkable fact that in America as on the Continent, direct current machines appeared to be almost universal, whereas in England alternating machines were in very general use. Atmospheric electricity, secondary batteries, telephones, had papers devoted to them, but they did not call for comment. With reference to the Philadelphia Exhibition he would not say anything, as Prof. Forbes would read a paper before the Society on the subject.

When the author visited America in 1877, he found a great deal to learn and take advantage of; but since that year he found that practically no advance had been made, whereas we in England had rapidly advanced. As regards the material progress, he would mention that in 1877 the mileage of wire in America was 200,000, whereas in 1884 it was 433,726. The number of messages had increased from 28,000,000 to 48,000,000; the number of offices from 11,660 to 13,600; whilst the capital invested had increased from 40,000,000 to 80,000,000 dollars. The Western Union Company had, in fact, made great material, but no scientific progress. He should state, however, that a novelty in the shape of the Delany multiplex * had been experimented with, and gave promise of good results. This apparatus would be shown at the coming Inventions Exhibition, and would be also probably tried on the Post Office wires. Although we in England had not hesitated to adopt foreign systems, yet the reverse was not the case except as regards the Wheatstone instruments, which were coming into extended use in the States. The telephone industry had passed through an awkward phase, determined attempts having been made to upset the Bell patents. In the author's opinion, the pretexts upon which the attempts were founded were of the flimsiest possible description. The extent to which the telephone was in use in the United States could hardly be imagined in this country; this extensive use existed in spite of the restrictions which existed, which were far greater than they were in this country. One company, he might mention, was taxed to the extent of 75 per cent. of its receipts. The reason why the telephone was so extensively used was because it was a vital necessity for business, partly in consequence of the excessive heat preventing exertion to a great extent. The extensive employment of electric signals for domestic purposes was in a great measure due to the high rate of wages rendering it cheapest to have ordinary errands done by an organised corps of messengers called by signal when required. The charges for telephonic communication were higher than in this country; the annual charge for the "law" system (a system employed by lawyers) being £44; the ordinary charge was £35. In Chicago it was £26, and in Boston and Philadelphia £25. Buffalo, exceptionally, had a charge by results; the rate being 6, 5, and 4 cents. per call, according to the guaranteed minimum number of calls (500, 1,000, and over 1,000, respectively). The instruments used are no better, and in many cases are worse, than those used in England. The exchange system was, however, infinitely better carried on, partly because the public do their best to assist the companies in the matter, and are very forbearing. Liverpool, in this country, however, compared favourably with the American service. At Milwaukee, the maximum time of putting through was four seconds only. There were in use 97,400 telephone circuits worked by 90,000 miles of wire, whilst 517,000 instruments had been manufactured; in New York there were 10,600 subscribers, whereas there were but 11,000 in the whole of England. The electric lighting system was making great progress, but the general use of high tension currents, with overhead wires mixed up with other circuits, was most objectionable, and several fires were clearly traced to this arrangement being in use. The appearance of the wires was also most unsightly. The use of cut-outs, which worked when a current exceeding 1 ampère passed through a telephone line, was becoming general, and many accidents were avoided by their use. Edison had undoubtedly solved the problem of the centralisation of electric lighting. Amongst other workers, Edward Weston deserved mention as having brought electric lighting to a great pitch of perfection. The Western Electric Company was doing a very large business in electric light plant. About 90,000 arc lamps were now in use in the States. In conclusion, Mr. Preece referred to the great variety of impressions with which different men, from personal observation, viewed America and Americans.

The result of the ballot for the council for the coming year was announced as follows:—

President—C. E. Spagnoletti, M.Inst. C.E. *Past Presidents*—Sir William Siemens, D.C.L., LL.D., F.R.S. (deceased); Frank Ives Scudamore, C.B. (deceased); Sir William Thomson, LL.D., F.R.S.; Latimer Clark, M.Inst. C.E.; C. V. Walker, F.R.S. (deceased), Sir Frederick Abel, C.B., F.R.S.; Colonel J. U. Bateman-Champain, R.E.; W. H. Preece, F.R.S., M.Inst, C.E.; Professor G. C. Foster, F.R.S.; Lieut.-Colonel C. E. Webber, C.B., R.E.; Willoughby Smith; Professor W. Grylls Adams, F.R.S. *Vice-Presidents*—Professor D. E. Hughes, F.R.S.; Sir Charles Bright, M.Inst., C.E.; Edward Graves; Colonel Sir Francis Bolton. *Council*—Members.—William T. Ansell; Professor W. T. Ayrton, F.R.S.; E. B. Bright, M.Inst. C.E.; R. E. Crompton, M.Inst. C.E.; William Crookes, F.R.S.; Dr. J. H. Hopkinson, M.A., F.R.S.; Colonel E. D. Malcolm, C.B., R.E.; Alexander Siemens; Augustus Stroh; Major R. Y. Armstrong, R.E.; Professor George Forbes, F.R.S.E.; Joseph W. Swan. *Associate Members of Council*—Lieut.-Colonel A. C. Hamilton, R.E.; O. E. Woodhouse; Alexander Pelham Trotter. *Hon. Treasurer*—Edward Graves, V.P. *Hon. Secretary*—Colonel Sir Francis Bolton. *Auditors*—J. Wagstaff Blundell and Frederick C. Danvers. *Hon. Solicitors*—Messrs. Wilson, Bristows, and Carpmael.

The meeting then adjourned.

* See ELECTRICAL REVIEW, February 2nd, 1884.

Physical Society.—December 13th.

(Prof. GUTHRIE, president, in the chair).

THE following communications were read:—"On the effect of an electrical current on the rate of thinning of a liquid film." By Profs. A. W. Reinold, F.R.S., and A. W. Rücker, F.R.S., read by Prof. Reinold. In 1877 the authors communicated to the Royal Society an account of some experiments upon the electrical resistance of liquid films. The results then obtained showed that there was some disturbing influence present, and the authors now find this to be the action of the current upon the film itself. The films experimented on were, as in the original experiments, cylindrical and vertical, formed upon two coaxial platinum rings, which are the electrodes by which an electric current can enter and leave the film. The mode of formation of these films and the precautions necessary to keep them from gaining or losing moisture by condensation or evaporation have been already described before the Royal Society [Phil Trans., 1881, Pt II.]

When such a film just formed is left to itself, it shows a set of colours of different orders arranged in horizontal bands; as it thins under the action of gravity these bands gradually broaden out and descend; a black band soon appears at the top which likewise extends downwards. If a current is now passed downwards through the film the motion of the colour bands is accelerated, showing that the effect of the current is to assist gravity in thinning the film; the black band, however, becomes in part or entirely white. This, upon examination, is found to be due to the following action: the film is not directly dependent upon the upper ring, but is attached to it by a comparatively thick mass of liquid. The action of the current is to transfer liquid in its own direction, thus, like gravity, thinning the film; the mass of liquid however on which the film hangs by this same action is forced down into the black portion, which consequently becomes white. If the current be passed upwards the reverse effects occur; the downward motion of the bands is retarded, or, with a strong current, reserved. The explanation is precisely the same as before; the liquid is transferred along the film in the direction of the positive current; it sometimes collects in the form of pendent drops attached to the upper ring, these increase in size and stream down the sides of the film. Prof. Reinold then formed a plane film between two horizontal wires, the film was illuminated by the lime-light and its image projected upon a screen, the motion of the bands of colour in the direction of the current produced by 50 Grove's cells was clearly shown.

In a discussion which followed upon the transference of matter with the current, Prof. AYRTON described some experiments recently made by Prof. Perry and himself which showed that certain metals were carried through mercury in the direction of the current.

Mr. BOYS remarked upon the apparent inertia of the film; the current seemed to require time to develope its action, no motion of the colour-rings being visible for some seconds after making the current.

Dr. STONE exhibited a tuning-fork interruptor commutator. This is an instrument for reversing an electric current through a circuit a given number of times per second. From the free end of a spring, kept vibrating in unison with an electrically maintained fork by an electro magnet in the circuit of the fork acting upon an iron armature attached to the spring, project two small aluminium plates, side by side, but insulated by ebonite from the spring and from each other. These are connected by fine wires which do not interfere with the vibration of the spring, to screws upon the base of the instrument, to which the poles of a battery are joined. The motion of each plate is arrested upwards and downwards by aluminium stops, so that there are four such stops arranged at the corners of a rectangle. They are connected in pairs, diagonally, and each pair is in communication with one end of the external circuit. Thus, when the spring is up the current flows to the aluminium plates and is transmitted through the circuit in one direction. When the spring is down it flows by the lower stops in the opposite direction. The electromotive force is thus reversed in the circuit twice as many times as the fork vibrates per second.

Mr. LEWIS WRIGHT exhibited his new oxy-hydrogen lantern microscope; details of this instrument will shortly be published. Geological, medical, and biological specimens were exhibited upon the screen with great distinctness, the definition being singularly perfect under the highest powers.

NEW PATENTS—1884.

15889. "Regulating and controlling electric clocks and apparatus therefor." W. P. THOMPSON. (Communicated by C. H. Pond and others.) Dated December 3.

15898. "Electro-magnet and solenoid cores." H. F. JOEL. Dated December 3.

15908. "Applying magnetic force to the closing of doors, boxes, hand bags, &c." R. S. Moss. Dated December 3.

15918. "Producing vacua in incandescent lamp bulbs." C. H. STEARN. Dated December 3.

15925. "Switches or commutators for electrical currents." S. W. CUTTRISS. Dated December 4.

15946. "Electric arc lamps." F. C. PHILLIPS. Dated December 4.

15965. "Carbons for electric lighting." R. J. RAE. Dated December 4.

15969. "Working gear and appliances used in electric lighting." K. W. HEDGES. Dated December 4.

15987. "Magneto-electric appliances for curative and remedial purposes." M. E. SCOTT. Dated December 5.

16006. "Electric lighting in conjunction with fire-proof ceilings and walls." J. H. MUSGROVE-MUSGROVE. Dated December 5. (*Complete.*)

16007. "Telephony and telegraphy." J. STEPHEN. Dated December 5.

16009. "Renovation of Lechlanché's battery." H. GILLARD, A. MARESCOT. Dated December 5.

16016. "Measuring electric currents." J. C. MEWBURN. (Communicated by P. C. Gerboz.) Dated December 5.

16056. "Inference wires on electric bobbins for bells, dynamo or motive-power." J. B. DENNIS. Dated December 6.

16082. "Microphonic transmitters." W. L. WISE. (Communicated by A. De Jongh.) Dated December 6.

16104. "Illuminating velocipedes by electricity." S. W. CUTTRISS, T. GAUNT. Dated December 8.

16112. "Accumulators—system Planté." H. GILLARD, A. MARESCOT. Dated December 8.

16116. "Electric current regulators for incandescent electric lamps." G. A. NUSSBAUM. Dated December 8.

16120. "Apparatus for operating electric devices." J. BOWIE, W. TURNER, M. HILL. Dated December 8.

16124. "Manufacture of magnetic necklaces, bracelets, armlets and lockets." F. W. HEMBRY, W. S. HAYWARDS. Dated December 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

13. "Improvements in electro-magnets." W. LEFFLER. Dated January 1. 2d. Relates to electro-magnets, in which it is of importance that the armature shall not remain attracted after the electric current has ceased to flow; and as the armature does sometimes remain attracted, commonly called "armature sticking," the inventor has invented a simple device for overcoming such attraction. In carrying the invention into practice, he provides permanently magnetised steel armatures to be alternately attracted and repelled according to change of polarity in the electro-magnets, such change of polarity being caused by reversing alternately the direction of the electric current by means of a commutator which is provided. This commutator is interposed in the electric circuit, so that by a slight movement of the same the current is reversed, causing a change of the polarity in the electro-magnets whereby the armature is attracted and repelled. Sometimes the inventor provides soft iron armatures, round which is coiled insulated wire through which the electric current passes, converting the soft iron into temporary magnets, to be attracted and repelled; should the current in the armature be reversed, then the current in the electro-magnets must not be reversed.

409. "Improvements in electric lamps." S. H. EMMENS. Dated January 2. 4d. The inventors construct the lamps by placing the required number of cells in a suitable case provided with a cover fitting water-tight by means of rubber-packing or otherwise. To this case they attach a boss or base-piece carrying contact-pieces at the rear, which make circuit with the poles of the battery when the boss is placed in position. Locks may be provided for fastening the cover and boss in their places, and the lamp attached to the boss may be closed in by a lantern, globe, or cage, and thus no part of the galvanic circuit is exposed, and no sparking can take place. In the case of single fluid cells the circuit is closed or opened, and the light produced, augmented, diminished, or extinguished by raising or lowering a head-frame or head-frames by which the electrodes are carried, such raising or lowering being effected by a screw, rod, or cord operated from the outside of the case, and where necessary closed in by a pipe or covering of rubber or other suitable material. In the case of double-fluid cells the circuit is closed or opened by a movement of the boss, or by a separate contact-piece operated by an internal screw, button, or push worked from the outside of the case, and where necessary covered in by India rubber or other suitable material. The inventors also provide for the contingency of the battery being required to work a separate lamp. This they effect by affixing two outside terminals capable of being brought into circuit with the poles of the battery by a movement of the said boss; or, alternatively they provide two separate terminals under a locked cover, or they make the said boss removable and capable of being attached by any desired length of wires to the internal poles of the battery.

10965. "Improvements in and relating to mechanical telephones." H. H. LAKE. (Communicated from abroad by J. B. Bennett, of America.) Dated August 6. 6d. Relates to the construction of appliances for transmitting speech, known as mechanical telephones, and it consists partly in insulating the operative parts of the device from the box or case in which they are enclosed, whereby all sounds or vibrations coming from the wall of the building, or wherever the instrument is mounted, are effectually cut off from the said operative parts; also in insulating the whole device from the wall, or whatever it is mounted upon. It further partly consists in providing a door or cover for the mouth of the transmitter, which door or cover is adapted to move beside the said mouth when it is desired to use the telephone, and which, when a conversation is completed, may be thrown up and cover the said mouth.

CORRESPONDENCE.

Compounding Dynamos.

I think it would be of value to your readers if a correspondent would kindly give a few practical details on "how to compound a series dynamo."

I have a dynamo (series incandescent) capable of running 70 lamps, and should like to know the gauge, length, and turns of series wire to be wound on the field magnets, in order to compound the machine, and of course expect to get a less number of lamps than formerly.

If a correspondent would kindly furnish me with the necessary experiments to be made, and what data are required before the above can be done, it would much oblige

W. McWilliam.

Invergarry, Crouch Hall Road,
Crouch End, N.

The Magic Lantern and Incandescent Lamps.

The question of the adaptibility of the electric light to the optical lantern has now been under discussion for some little time, and the correspondence columns of the technical journals have recently given the experience of some of our operators in this direction. They have, however, mostly referred to the use of the arc light. It may, or may not, be well known to your readers that the incandescence lamp is perfectly well-suited for use in the lantern.

From an experiment recently made with a Bernstein sixty-candle lamp, I find that a well-lighted and clear disc can be obtained; and by raising the power of the current somewhat beyond that usually used for the lamp, the disc had the appearance of one illuminated by the best form of the lime-light.

Auto.

December 17th, 1884.

Foreign Specifications.

In reply to the enquiry of "Pentalpha," copies of foreign specifications of patents, cannot, so far as I am aware, be purchased in this country. Your correspondent's best plan is to order such as he requires through an English patent agent having agents in the respective foreign countries.

Thos. J. Handford.

42, Southampton Buildings, W.C.,
December 15th.

Telephone Patents.

Having read with much interest the replies of "Common Sense" to the questions propounded by Major Barney in your issue for November 29th, I should like to have the opinion of any of your correspondents as regards the following points.

1. Is the employment in a telephone receiver of a permanent magnet as a core, or to magnetise the core of the inducing coil, an infringement of the Bell patent as amended by disclaimers, &c., at the present time?

2. Is an electro-magnet excited by a battery in a local circuit, and employed as above, an infringement of the same patent?

3. Is an electro-magnet excited by a local battery and having a second coil for the line currents an equivalent of a permanent magnet with only one coil, and are either or both of these equivalents of an electro-magnet excited by a battery in the main circuit or line wire?

4. The last named arrangement having been disclaimed from the Bell patent, are the other arrangements free also?

I have to thank "F. T. H." and "Common Sense" for their former answers to my queries; perhaps they will be kind enough to answer the above as well.

S.

December 15th, 1884.

The Bell and Edison Telephone Patents.

The importance to which opinions are entitled depend either upon the high standing of the giver of them, or upon established facts or conclusive arguments cited in support of them. In the letter of "F. T. H." in the REVIEW of 13th inst., I fail to find established facts or conclusive arguments cited by him in support of his opinions, and surely the initials "F. T. H." have not that high standing which could give any weight to his opinions.

I know well that newspaper controversies seldom lead to any beneficial results; for, among other reasons, there is no umpire to decide finally upon the questions of the controversy. I did not think that my letter in the REVIEW of 22nd November could lead to any controversy. I simply propounded a series of questions, and I asked you and your readers to enlighten me thereon.

I fancy that I know "a hawk from a handsaw," and that I have not confused the "alterations" with the "disclaiming notes."

I submit that the "alterations" introduced into the claim by adding these words, "subject always to the disclaiming notes," may enlarge the scope of the patent, or may narrow it. The effect of those words depends upon the disclaiming notes and *memorandum* of *alteration*. I know that if by an alteration the scope of a patent be enlarged, the patent itself is bad, and I expressed my opinion that the substitution of the words "equivalent plate" for the word "material" does enlarge the scope of the patent, and on this point I asked opinions of scientists. Your correspondent says that I have raised this "ghost," and proceeds to say that it has already been "judicially laid," and then quotes from Mr. Justice Fry's decision these words:—"The description of the subject matter of the plate is adequate: the plate described must be inductive and equivalent to a steel plate, as regards its capacity to vibrate with the voice. When these qualities are found it seems to come within the description contained in the amended specification." Your correspondent expresses his opinion that a plate of wood and bar armature is not such a plate as comes within the description in the Bell patent, and his arguments seem to establish that fact. I entertain the same opinion in regard to the non-inductive plate with bar armature, and I have on many occasions in the REVIEW expressed that opinion; notably in the REVIEW of 16th and 23rd November, 1882, where will be found my correspondence with the solicitors of the U. T. Co., who wrote that the counsel of the U. T. Co., Mr. Moulton, was of opinion that the Lockwood-Bartlett receiver was an infringement of the Bell patent. This L. & B. receiver had a wooden plate with a bar armature. Here, then, is the opinion of a barrister learned in the law, and an amateur electrician also, that such a plate is claimed by the U. T. Co. as within the Bell patent. This claim is still persisted in by the U. T. Co., as also the claim to the exclusive use in a transmitter of Hughes's carbon microphone, so held in a frame that there is nothing above or below the carbons. Their claim to the wooden plate with bar armature must rest solely on the words "equivalent plate," for surely such a plate cannot be included in the words "other *material* capable of inductive action."

I submit that if the Court should sustain the claim that the wooden plate with bar armature is within the patent as amended, then the scope of the original patent has been enlarged by the memorandum of alteration, and the consequence will be that the patent would necessarily be adjudged to be void. The object of my letters in the REVIEW of 29th November and 6th December, was simply to elicit the opinion of scientists as to the effect of the substitution of the words "equivalent plate" for "material" in the patent, and I beg to express my thanks to "F. T. H." for his opinions and reasons therefor.

W. C. Barney.

December 15th, 1884.

The "Bell and "Edison" Telephone Patents.

I am inclined to agree with "F. T. H." that a plate of wood with an iron armature attached is not included in the Bell patent, but I repeat "if by the substitution of the words 'equivalent plate,' any plate would be included which could not be included by the word 'material,' then the scope of the patent is enlarged, and the patent is void."

I do not consider that the judgment of Mr. Justice Fry settles that point. The question of a plate of wood with iron bar armature was not before Mr. Justice Fry. The point raised in Mr. Barney's eighth question is the important one, and "F. T. H." has solved it no doubt to his own satisfaction, but what a court may decide on that point is yet in great uncertainty. I learn, however, from the REVIEW that Mr. Barney has brought an action against the United Telephone Company, and it is to be hoped this point will be raised and adjudged upon.

In regard to the Hughes microphone, I refer "F. T. H." to *Engineering*, May 10th, 1878, pages 370, 371, where he will find that Hughes's microphone as devised by him was attached to a tympan or diaphragm, *using those words as defined by Mr. Justice Fry*.

Mr. Conrad Cooke in his statement that "none of Hughes's microphones use a diaphragm to convey articulate speech" must be taken with the meaning Mr. Cooke attaches to the word diaphragm, which I am inclined to believe was not the same as that of Mr. Justice Fry. And I must now repeat my request to "F. T. H." to give me a description of Hughes's microphone without a diaphragm which will transmit articulate speech.

The transmitter of which I spoke as being without the vestige of a diaphragm was made of wood and carbon, and the carbon or tension-regulator was not "hung upon a sunbeam," nor did it "ride upon a sound-wave"—but it was a novel form of Hughes's microphone *without the semblance of a diaphragm or tympan*, and "F. T. H." will no doubt be able "to learn the mystery of its construction" shortly, before one of the Judges of Chancery.

I maintain, that according to the judgment of Mr. Justice Fry, a tension-regulator in combination with a a resonant case is clearly within the Edison patent, for the reason that if placed inside, or on top of the resonant case, there must necessarily be some part of the case either above or below the tension-regulator.

Common Sense.

December 15th, 1884.

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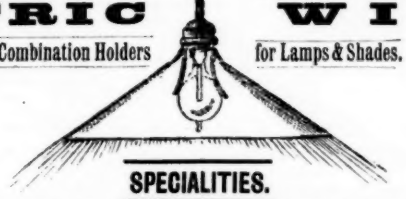

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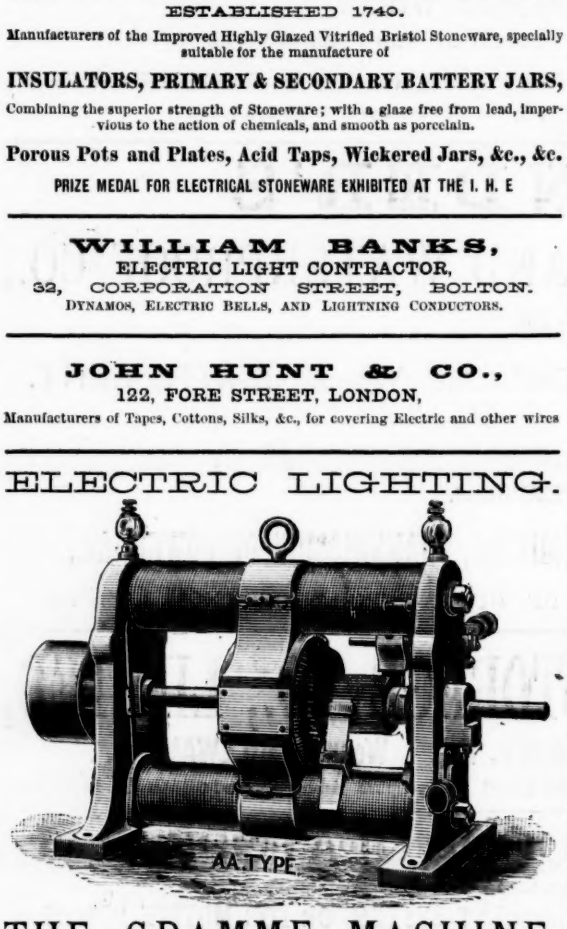

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